# Technology Review

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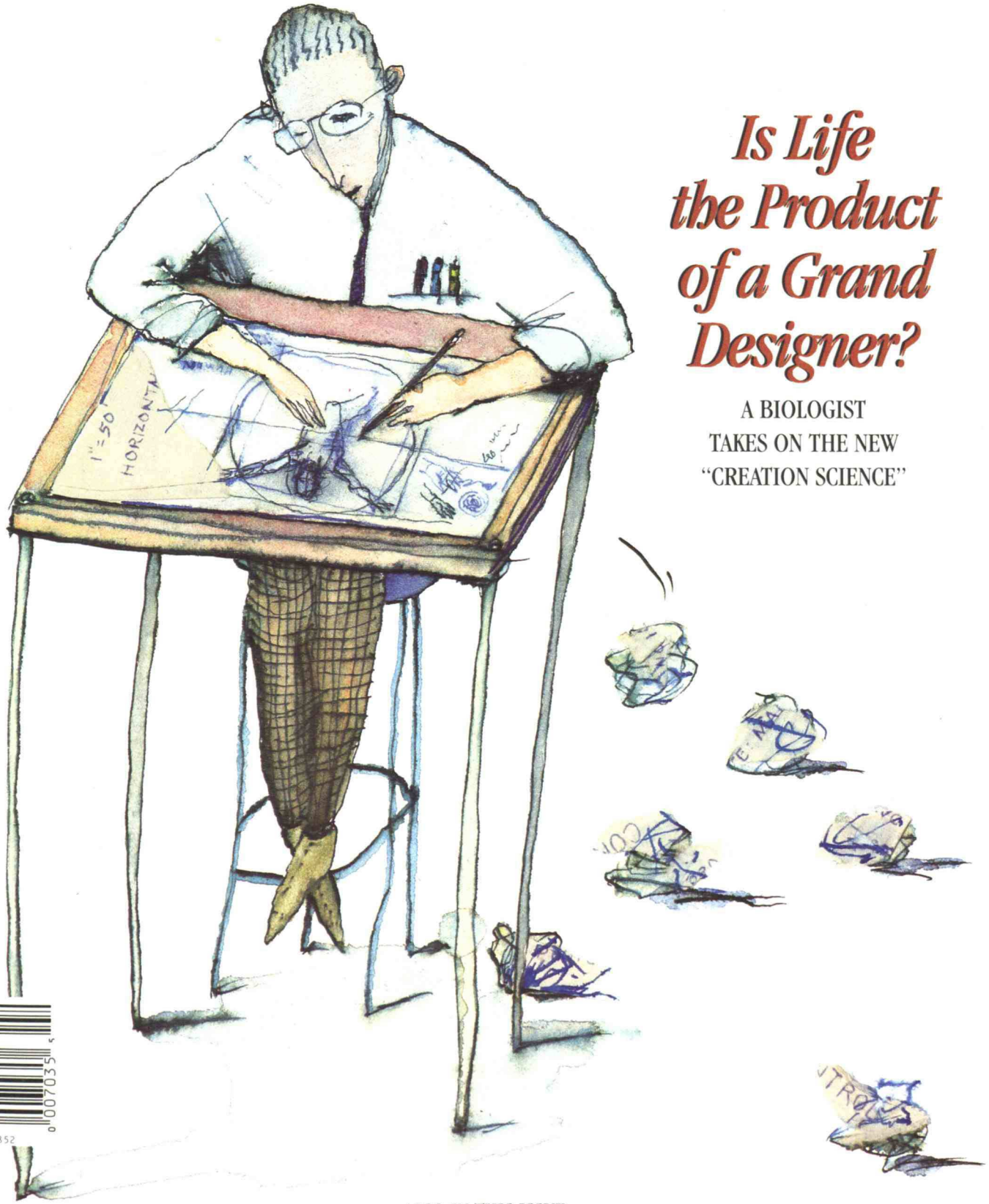

## *Is Life the Product of a Grand Designer?*

A BIOLOGIST TAKES ON THE NEW "CREATION SCIENCE"


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FEBRUARY/MARCH 1994

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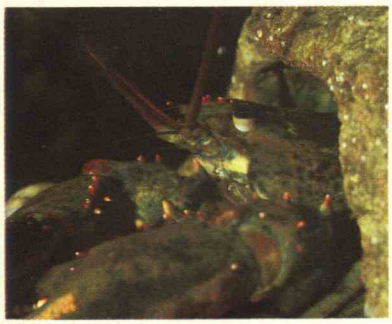

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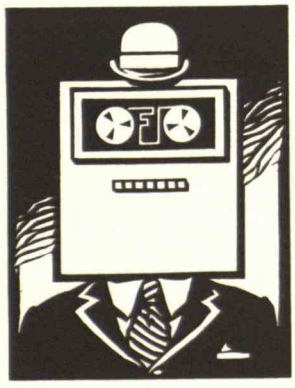

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# First Line

## The Latest in a Series

In my previous job as editor of *Issues in Science and Technology*, one of our advisers expressed worry one time about a too-steady drumbeat. "Steve," he whispered in my ear, "there are other health problems besides AIDS." The reference was to a series of articles we had been publishing, over a two-year period, on topics such as the AIDS research agenda, how to teach children about the disease, the spread of the AIDS epidemic in developing countries, and lower-cost but more humane ways to treat patients.

At *Technology Review*, we've been running a comparable series over the past couple of years, and I keep wondering if someone will similarly point out that "there are other people besides women." We have lately presented, among other stories, "Women of the Manhattan Project," "Confronting Breast Cancer," an excerpt from a historian's book-length analysis of centuries-old barriers to women in science and related fields, and an article on efforts to build a women's engineering institute. In this issue, we offer "Training Doctors to Care for Women," which reports on the medical community's heated debate over a proposed new specialty in women's health.

So why all that AIDS discussion back then, and why the seeming preoccupation with women now? Does either case force upon our readers some editor's personal agenda?

Actually, these articles were driven not by editorial design but by world events and principal players, some of whom became authors or major sources. In the case of AIDS, the articles were inspired by a potent and inevitably fatal new disease that had nevertheless been largely overlooked and inadequately prepared for. In the case of women, the articles have been impelled by an altogether different "disease," one that has long rendered gross injustice to half of humanity but that has become particularly timely because of the ideas of informed and influential people determined to subdue it once and for all.

Our duty as journalists is to recognize and report on such emerging and critical issues. And our duty as *Technology Review* editors is not only to illuminate yet another critical aspect of our beat of "technology and its implications" but to empower our audience—to present readers with material, covered lightly or not at all elsewhere, in sufficient depth and breadth so that they can take action to address the situation themselves if they wish.

*Sometimes a single installment is just not enough.*

Women clearly enjoy fewer opportunities to pursue science- and technology-related careers to the full extent of their abilities: in fields that are seemingly open, they usually rise only as far as the infamous "glass ceiling"; in others, they often don't begin rising in the first place, held down by an equally infamous "sticky floor." In either case, they receive less recognition and lower pay than men of equivalent competence.

The problem is certainly well known, and *TR* has no intention of belaboring it. We seek to concentrate instead on what thoughtful protagonists in the drama, and those who influence them, propose to do about it.

This issue's "Training Doctors to Care for Women," by physician Adriane Fugh-Berman, is a prime example. And it addresses solutions that reflect the growing trend of "separateness"—segregation, at least occasionally, in order to build peer groups, establish role models, encourage specific strengths that often get suppressed in mixed groups, and deliver improved performances. For example, building in part on the remarkable fact that women's liberal-arts colleges have long produced disproportionately more female scientists than coed schools, some proposals would take the trend to its limit and establish all-female science and engineering academies (*see "A Women's Institute of Technology?" TR April 1992*).

Similarly, experiments in primary and secondary education are under way in which girls receive instruction in science and math separately from boys. Advocates argue that such arrangements serve male and female students alike, who can then function in class in ways that best suit their sex, especially at that time in their lives.

A similar though far more extensive system is envisioned for health care: establishing medical practices administered mostly by women and exclusively for female patients. Advocates insist that this is not only a good way to improve efficiency and eliminate lapses in communication—a woman's routine health care is typically fragmented among several practitioners—but that it would much improve the quality of female health care, which, as Fugh-Berman notes, "remains deficient."

Such separation is not envisioned as the only game in town, much as girls' high-school math courses or women's engineering schools will not likely predominate. Instead, a specialty in women's health could provide a center of excellence that would spread the wealth. "The status of a specialty," asserts one of the advocates cited by the author, will "improve conditions for women by creating an identifiable pool of experts from which doctors in other specialties will learn."

Such a power base could improve health care not only for women. "It may even have a substantial impact on medicine in general," suggests Fugh-Berman, "since the philosophy behind a women's health specialty, which emphasizes treating the patient as a whole person and establishing a partnership between patient and physician, is something that many people, men and women alike, are eager to learn how to put into practice." ■

—Steven J. Marcus

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# Letters

## THE REAL VALUE OF THE SPACE PROGRAM

In "What Price, Columbus?" (*TR Forum, November/December 1993*), Alex Roland compares the gold and silver brought back by the Spanish treasure ships to the moon rocks brought back by the Apollo astronauts. This misses the mark entirely. The real value of the space program lies in helping to launch the information age.

Today earth satellites provide us with global communications, weather surveillance, treaty verification, and earth studies not otherwise possible. Although it will be a long time before we are able to assess the space program's impact on our lives, it is already clear that we are deriving far more benefit from it than the Spanish ever did from their treasure ships.

ALBERT M. CARTER
Greensboro, N.C.

## SOVIET NUCLEAR LEGACY

In "Palchinsky's Travels" (*TR November/December 1993*), Loren R. Graham provides clues to the demise of the Soviet Union as well as important lessons for the education of engineers. Unfortunately, the effects of the former Soviet Union's "intellectually impoverished . . . and ethically lame" engineering education live on today.

During the Cold War, the former Soviet Union routinely dumped high-level nuclear waste into the earth's air, land, and water. In March 1993, a report issued by the Russian Federation indicated that the USSR had dumped 18 nuclear reactors from submarines and an icebreaker into the shallow waters of the Kara Sea and the Sea of Japan. The Kara Sea site, near major northern fisheries, is now known as the world's largest nuclear dump.

Such policies did not end with the Soviet Union. In October 1993, Russian officials claimed they had "no choice" but to keep dumping nuclear waste at sea. This announcement came after Japan protested that Russia had dumped some 900 tons of low-level nuclear waste from decommissioned nuclear submarines into the Sea of Japan.

J. RICHARD SHANEBROOK
Professor of Mechanical Engineering
Union College
Schenectady, N.Y.


## NO SOFTWARE DEVELOPMENT IN DEVELOPING COUNTRIES

I share the concern of Suzanne P. Weisband and Seymour E. Goodman about the use of illegally copied software in developing countries (*"Subduing Software Pirates," TR October 1993*). I am from a developing country myself, and I have worked in another developing country where you can purchase a pirated copy of the latest version of Lotus 1-2-3 for a dollar per diskette (although its copied software manual costs at least $50).

In general, software now sold legally in developing countries costs about five times what it does in the United States. Computers are rather expensive to begin with, and adding high software prices puts them out of reach for many, especially students. Furthermore, if people don't have access to computers, they may never become computer literate, which could hurt the software industry. After all, only computer literate people can buy and use software.

But I do not believe that helping firms

in developing countries create original software, as the authors suggest, is an answer to the problem. Rather, it is in the interest of U.S. software companies to prevent piracy by making sure their products are sold in those countries at a price comparable to or lower than the U.S. price. People naturally want to use Lotus 1-2-3, Quattro Pro, or some other such program for their spreadsheets. Nobody would want to learn a different and inferior spreadsheet program when a better one is available and its compatibility is assured.

A. KERIM KAR
Visiting Lecturer
Department of Mechanical Engineering
MIT

## NO DIRECT FEDERAL SUPPORT

In "Nurturing Winners with Federal R&D" (*TR November/December 1993*), Don E. Kash and Robert W. Rycroft correctly note that government support for science is "cumbersome and ineffective." Spinoff benefits from federal projects do indeed arise "randomly and at great cost," if at all. But I do not agree that "federal support of commercial technologies has to be more direct."

In fact, federal R&D spending makes sense only if markets systematically underinvest in technological R&D, and there is no reason to believe that this is the case. Even if it were, Kash and Rycroft wouldn't know what to do about it: they want the federal government to "establish a well-funded but politically insulated corporation." In Washington, D.C.? No doubt if these authors were in charge, federal R&D spending would produce much benefit. But as long as politicians occupy Congress, techno-pork projects will just happen to wind up going to the home states of the politically powerful.

JOHN O'LEARY
Reason Foundation
Los Angeles, Calif.

## DRAWBACKS OF BUSES

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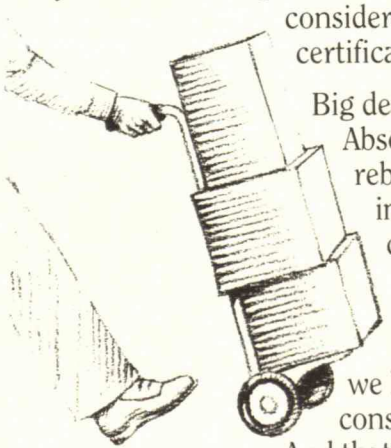

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"Boom and Bus" *(TR Trends, November/December 1993)*. For example, how many lanes of traffic are used by the buses that supposedly rival the transport capacity of one subway line? Would it even be possible to substitute the necessary number of buses for a subway? Still less believable is the claim that the government need not subsidize buses—it's backed by nothing. Substituting for real information are a picture of a glossy new bus and equally glossy statements from proponents.

In reality, the bus remains a labor-intensive, air-polluting stopgap measure, and its main charm is the ease with which service can be cut back or eliminated. In a more perfect world, engineers would be among the first to realize that no miracle of "competition" will cancel the inherent efficiency of steel wheel on rail, the long-term savings of a right-of-way, or the cleanliness of electric propulsion. What's more, the "price-setting strategy and competition" behind buses seem likely to encourage the use of unqualified drivers and discourage proper maintenance and replacement schedules.

In the long run, the bus strategy will result in polluted suburban development with no substantial investment in cost-effective urban transport. The scenario is suitable, in the World Bank's view, for a population controlled by the army of Brazil, but it's worth noting that Portland, Sacramento, San Jose, and San Diego are not interested. These cities, all of which have efficient light-rail lines, have experienced the bus era and decided they need something better. It will be interesting to see what the people of Brazil choose when—or if—they gain the ability to make a choice.

TERRY SCOTT
Seattle, Wash.

## EDUCATION VS. LEARNING

In "Video Games that Teach?" *(TR November/December 1993)*, Herb Brody seems unwilling to admit the inescapable conclusion of his own analysis: that education is the adversary of learning. The simulation gaming technology he persists in treating as mere entertainment is in fact a key component of learning—and one that is becoming more and more important. In the unfettered gaming environment, the learner is truly empowered. Every effort to coopt the technology to "educational" ends works to quash that power.

The point is that education is something done to people, while learning is what people are genetically designed to do for themselves. To fail to recognize this absolute and inevitable conflict is to remain rooted in an erroneous model of learning contrived for a factory economy whose time has long since passed. The term "edutainment" resembles "horseless carriage": it implicitly recognizes that something new has arrived while clinging pathetically to the vestige of a dead era.

LEWIS J. PERELMAN
Senior Fellow
Discovery Institute
Seattle, Wash.

## LIMITS OF MARROW TRANSPLANTS

As Ronald Kline notes in "New Marrow for Old" *(TR November/December 1993)*, bone marrow transplantation, or BMT, may someday be used to treat currently incurable or debilitating conditions. But for now, the procedure should be performed only in the context of well-designed clinical trials.

Curing a genetic disease, for instance, may not reverse damage that occurred before or during BMT. A history of stroke, the most common indication for bone marrow transplantation in patients with sickle cell anemia, could mean there has been so much vascular damage that the risk of future strokes would remain despite a completely successful transplant.

Also, BMT may accelerate the accumulation of toxins from metabolic processes, and these may not be cleared for 6 months or longer. Thus, a transplant may actually hasten degeneration of neurological function. In fact, one study of BMT for sickle cell disease is being reviewed because of several debilitating or fatal neurological events among "cured" transplant recipients.

Similarly difficult issues must be considered in using BMT to treat cancer. For example, the efficacy of one form of transplantation—that of removing a patient's marrow, purging the malignant cells, and then reinfusing it—has yet to be demonstrated. Indeed, many of the studies of this therapy have been carried out in clinical situations where the risk of relapse would exceed 50 percent even if the patient were receiving marrow from a donor known to be free of disease.

In this era of limited resources, the availability of a treatment is not enough justification to use it. We must recognize that we are not entering a medical shopping mall with a credit card and infinite credit.

Rather, we must rigorously demonstrate that BMT is better than alternative therapies as measured by disease-free survival, quality of life, and cost. Alternative approaches must include preventive strategies, such as prenatal diagnosis and screening, as well as therapeutic interventions.

STEPHEN A. FEIG
Professor of Pediatrics
Chief, Division of Hematology/Oncology
UCLA School of Medicine

## DISCRIMINATION: THE WAY IT WAS

"Women of the Manhattan Project" by Caroline Herzenberg and Ruth Howes *(TR November/December 1993)* opened my eyes. Most of us working at the lower levels of the project knew little of what was going on if it wasn't right around us.

I was a graduate student in organic

chemistry at Columbia University in the earliest years of the project, but from May 1944 to May 1946 I worked for Tennessee Eastman Corp. at Oak Ridge. In our department, which was charged with chemically purifying enriched uranium 235, the work was done mainly by young women, with supervision by young male chemists like myself. I have no knowledge of the pay these women received relative to the much smaller number of men doing comparable work, but I expect it was lower.

Racial discrimination, on the other hand, was obvious. One capable young African-American woman, a college graduate, worked in our department cleaning glassware. I was told we could not promote her to other work. I was much pleased when in 1958 I returned to Oak Ridge to take a short course and saw how much improvement had occurred in race relations.

WILLIAM R. LYMAN
Spring House, Pa.

## THE WORD ON THE MEALY BUG PROBLEM

In "Winning the War Against Mealy Bugs" (*TR Trends, November/December 1993*), Jane Stevens attributes the disastrous mealy bug infestation in Africa to a researcher who "*flaunted* strict international quarantine rules (italics mine)." This incorrect verb conjures up the image of an impudent plant breeder ostentatiously thrusting a sheaf of environmental regulations into the face of a customs inspector. Could it be instead that the culpable scientists contemptuously defied—*flouted*—the rules?

HAROLD P. BOAS
College Station, Tex.


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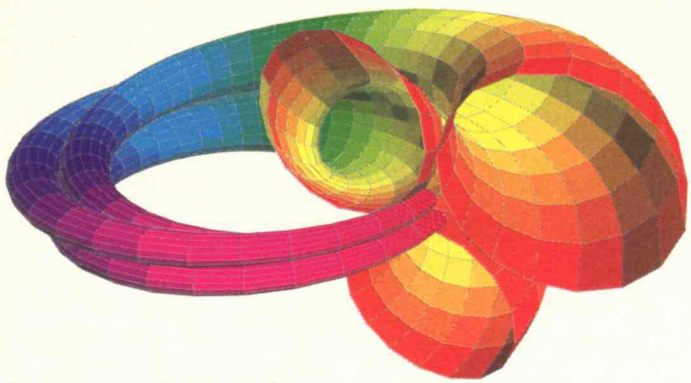

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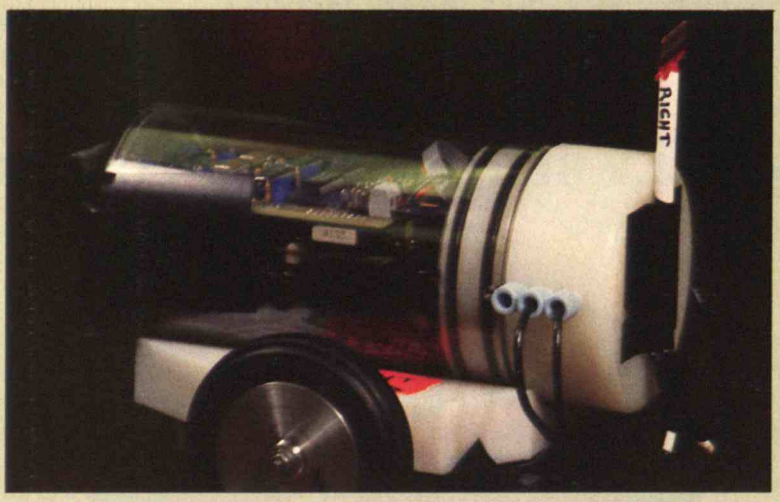
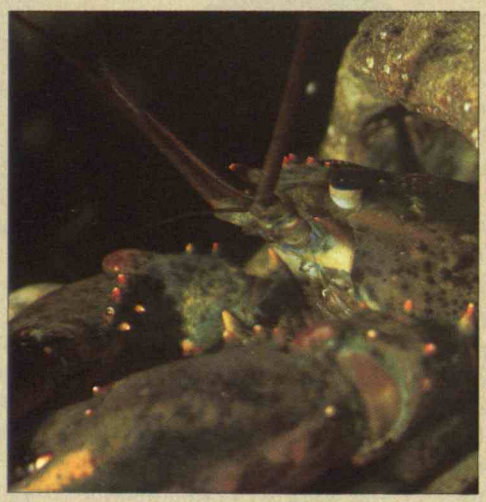


*Researchers at MIT and Boston University are developing a robotic "lobster" to detect and follow chemical trails. The robot's sensors, made of gold tines, poke out from the top of the machine's vertical pole, while the real animal's sensory devices—hairs—point down from the top of its small antennae.*

## Robotic Lobsters

It doesn't look like a lobster, walk like a lobster, or, most surely, taste like a lobster. But Thomas R. Consi, a research engineer in MIT's Autonomous Underwater Vehicle laboratory, and Jelle Atema, director of Boston University's Marine Program, are developing an eight-inch, metal-and-plastic shelled aquatic robot that moves on wheels and, according to Consi, "has chemical sensors similar to a lobster's antennae."

By trying to mimic the primary way lobsters find food—by detecting and following chemical trails—the device might provide data to aid in determining where New England's lobsterers could best set their traps. And fleets of the small autonomous "creatures" might be useful for tracing plumes of effluents as they disperse in seawater. For instance, says Consi, "We want to see if [the robots] can be used to guide a vehicle to the source of a chemical output."

During initial tests in MIT tanks, the researchers are using a simple conductivity sensor to trace variations in the salinity of water; salt disperses in water much as other dissolved chemicals do. Consi and Atema plan to substitute other chemical sensors that they will decide on as the research progresses; they will shortly switch to a test tank with currents at the Marine Biological Laboratory in Woods Hole, Mass. That tank has previously been used to test the behavior of real lobsters.

The early experiments are supposed to aid in developing, along with practical hardware, software for tracing chemical "scents." In these initial tests, the robot uses a simple strategy of "gradient following"—moving in the direction of a chemical's greatest concentration. But Consi and Atema do not expect this strategy to be very effective. They point out that better sensing techniques will be necessary because, in the open ocean, chemicals typically disperse in the form of disconnected patches. A lobster following a gradient would remain inside one patch as it wafted along.

Still, gradient following will provide a baseline against which the researchers can compare more sophisticated strategies later. One of these should entail getting the robot to move toward the area where a chemical concentration is undergoing the quickest rate of change. That could be close to the source, Consi says.

Consi and Atema are not the only researchers trying to copy what lobsters do. A team that includes Richard Blidberg, director of marine systems at Northeastern University's Marine Science Institute, has been working on creating robot lobsters that walk rather than roll. That may help the devices negotiate rough surfaces or travel through soft sediments. The researchers are developing software to coordinate the complex movements made by multiple legs.

Consi and Atema aren't ruling out other locomotion systems for their device, which has been designed as a modular system so that different components can be substituted as the experiments progress. "We want it to be something where researchers and students can play" and develop new strategies and mechanical components, Consi says, "a kind of lobster Lego."

—*David L. Chandler*

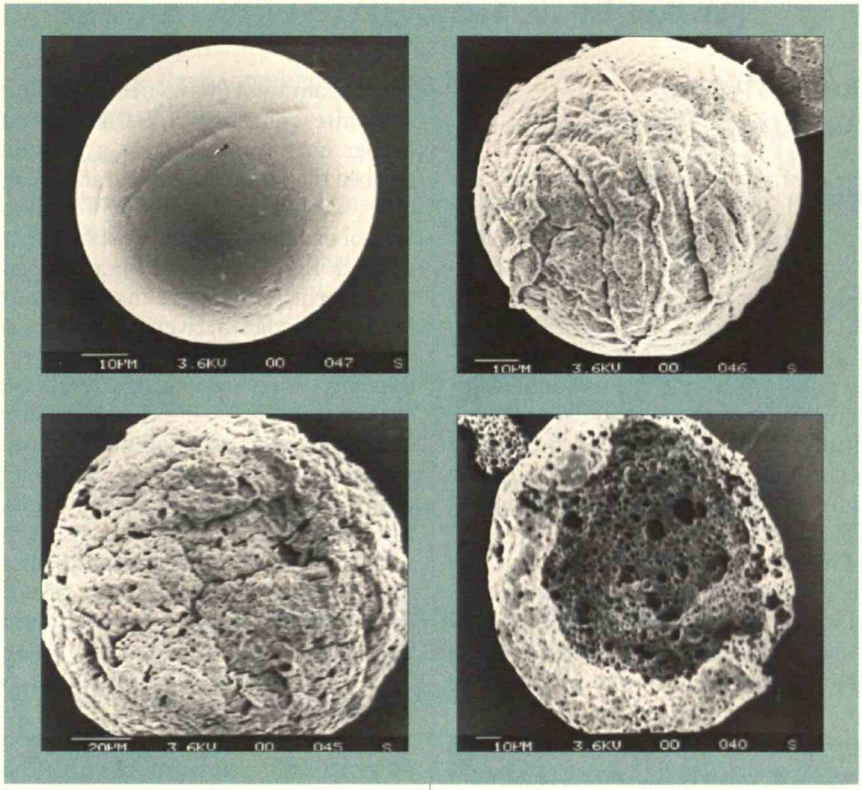
## Leaking Vaccine

Sometimes a little leakiness is a good thing.

By designing microscopic plastic balls to allow vaccines to seep out gradually, researchers at MIT and Harvard Uni-



PHOTOS: THOMAS R. CONSI; JELLE ATEMA




*Vaccines slowly diffuse through microscopic plastic balls injected into the body. The spheres also release vaccine as they degrade. These images were taken upon preparation and after days 4, 7, and 14 (left to right, top to bottom).*

versity think they've found a simple way to ensure that people are protected after a single immunization, eliminating the need for booster shots to establish long-term immunity to some diseases.

The spheres, each one-ten-thousandth of a meter in diameter, can be injected into muscle or fat, where they release vaccine for weeks, months, or longer. The expected result is constant stimulation of the immune system, with long-lasting protection against diseases such as diphtheria and measles.

The first malady that is targeted for the new delivery system is tetanus, a bacterial disease that "causes hundreds of thousands of deaths per year," says Robert Langer, Germeshausen professor of chemical and biomedical engineering at MIT. Langer is conducting the research with George Siber, an associate professor of medicine at Harvard University's School of Medicine, and Samadar Cohen and Maria Alonso, postdoctoral fellows at MIT.

If vaccine-saturated spheres end up working in people as they do in early tests of laboratory animals, a public-health problem affecting millions of people in developing nations may be alleviated, says Langer. Doctors working in those countries have learned that people often can't, or won't, return to clinics for necessary booster shots after being immunized once—in many areas, up to 70 percent of the individuals vaccinated. What immunity those people get is therefore short-lived and inadequate, and lives are lost. There could also be a follow-through problem in some areas of the United States, such as cities like Houston, where vaccination rates are low to begin with.

The spheres are made of a mixture of the polymers glycolic acid and lactic acid because those materials, approved for human use by the U.S. Food and Drug Administration, can be combined to leak at particular rates. Injected in muscle and fat tissues—where the spheres cannot migrate through the bloodstream to other organs—the vaccine both diffuses through the polymers and escapes as the plastic matrix dissolves in the body's fluids. Langer's team uses spheres because they are easy to inject and provide a large surface area from which the vaccine can leak.

### Effective Immunity

The microspheres have released tetanus vaccine in mice at a constant rate for six months (much of a typical mouse's lifespan), and have stimulated effective immunity from that moment on. Before the new vaccine-delivery technique can be applied to humans, Langer explains, testing is required in other relatively large animals, such as monkeys, cows, and sheep.

Langer and his colleagues are also including in the vaccine solution substances called adjuvants, commonly used to help stimulate the immune response. And the researchers are attempting to mimic the periodic delivery of booster shots by triggering the release of vaccine in pulses through the use of external magnetic fields and metal particles enclosed in the plastic with the vaccine. When subjected to a change in magnetism, the particles should jiggle and mechanically force out additional vaccine. Finally, the team is examining how coating the spheres with other plastics or changing their porosity alters vaccine-release rates.

The idea of controlled release of therapeutic substances is not new. Plastics in the forms of patches and implants are routinely used to deliver a constant, low-volume flow of medicines such as antiseasick potions and birth-control drugs. Langer first thought about using the general technique for vaccines in 1979, he says, "but nobody seemed to care about it for a very, very long time." Then, in 1990, concerned about diseases that have remained intractable, the World Health Organization wrote to Langer asking if he would conduct such research. "Now all of a sudden," he says, "there is a huge increase in interest."—*Robert Cooke*

PHOTOS: SMADAR COHEN

## PRODUCTIVITY PARADOX OR PAYOFF?

In two reports this past fall, the Clinton administration announced its commitment to the notion that computer and communications technologies can create a more efficient federal government and help revitalize the U.S. economy. The reports, on reinventing government and the national information infrastructure, pointed to the use of information systems as important tools to increase productivity, create high-paying jobs, and boost the sagging U.S. standard of living.

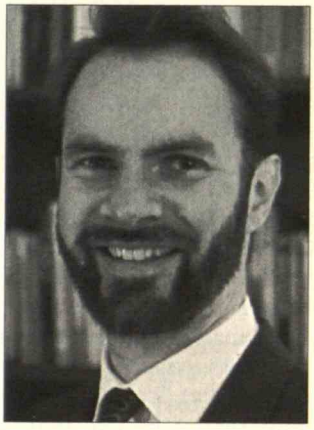
Given that corporate America has already plunked down an estimated $1 trillion for information systems, the relationship ought to be clear. In 30 or so major studies since the mid-1960s, however, economists have been unable to associate computer investments with higher corporate profits—a dilemma dubbed the "productivity paradox." But now, in a study from MIT's Sloan School of Management, assistant professor Erik Brynjolfsson and graduate student Lorin Hitt report that they have found a bridge between spending on information systems and improving productivity. After comparing overall sales against spending on information systems by 380 *Fortune* 500 manufacturers and service companies such as banks and utilities, the economists concluded that for every dollar invested between 1987 and 1991 in computer capital, more than 50 cents were returned in revenue each year. By comparison, all other forms of capital investment for manufacturing and service companies returned a paltry 6.9 cents.

"Dollar for dollar, spending on computer capital created more value than spending on other types of capital," Brynjolfsson says. "The productivity paradox disappeared, at least in our sample."

### More Recent, Detailed Data

Why have the MIT researchers found a relationship between productivity and spending on information systems when others have not? In part, Brynjolfsson credits more recent and detailed data. He and Hitt culled the amounts spent on computer capital from annual surveys conducted by International Data Group, a market-research firm based in Framingham, Mass. The economists collected more than 1,000 pieces of data, each representing one year of computer spending for a particular company. They then compared those numbers against company sales figures, as supplied by Compustat, a database that tracks financial statements. To isolate the effects of computer spending from those of other forms of capital investment such as employment, materials, and R&D, Brynjolfsson and Hitt subjected the data to "multiple-regression analysis." This statistical technique enabled them to estimate how much each investment contributed on average to the revenues.

In earlier studies, which relied on industrywide spending, economists did not look at how the different forms of investment related to each other—how, for instance, additional spending on computers might lower spending on labor—Brynjolfsson says. Also, in those studies, he points out, one company's gain in sales through computer investments would often be offset by another company's losses. (Of course, an overall gain due to investments in information systems would have shown up in the analyses.)



*Although other studies haven't correlated spending on information systems with improving productivity, recent research led by Eric Brynjolffson of MIT's Sloan School of Management has found a relationship.*

In their study, Brynjolfsson and Hitt have, however, left one area unexamined: the productivity impact of software investment. But Brynjolfsson doubts that numbers on software spending—which so far have not been available through International Data Group—would greatly change his team's conclusions. He bases his belief on "sensitivity analyses" that he and Hitt have made—simulations using a range of government-supplied figures for corporate software spending nationally. The returns on total computer investment "didn't change

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much," Brynjolfsson says, from those of hardware alone.

### Reshaping Business

The most plausible explanation for Brynjolfsson and Hitt's findings is that computers enable organizations to reshape the basic ways they do business, says Jerry Mechling, director of Harvard University's Program on Strategic Computing and Telecommunications. Pour information systems into an organization without first considering how work flows will change, what management layers to drop, or what new abilities to exploit, and the result will be an unproductive automation of obsolete processes. But organizations that exploit the new technologies to revamp fundamental business practices can experience a sharp upturn in efficiency, he notes. After some time, managers are finally learning this lesson, Mechling says: "Anytime you fundamentally alter industries, there's bound to be a long lag before the productivity starts to show up."

Still, not everyone has conceded the disappearance of the productivity paradox. If investments in computers have had such an enormous positive impact on productivity, the results should be showing up in broader economic indicators, argues Paul Strassman, formerly chief information officer for the U.S. Department of Defense. "When you look at real-income, per-capita growth, the standard of living in America has not increased," he says. "Our international competitiveness has declined, our trade balance is negative, and we have spent more on computers than on energy or natural resources for the last 15 years."

Those "government statistics are missing the boat" now, Brynjolfsson responds, because there is a lag time before they account for sales increases that are related to computers' effects in boosting quality and variety of products and customer service. He calls many of the statistics "industrial-age measurements for an information-age economy."

—*Stephen J. Shaw*


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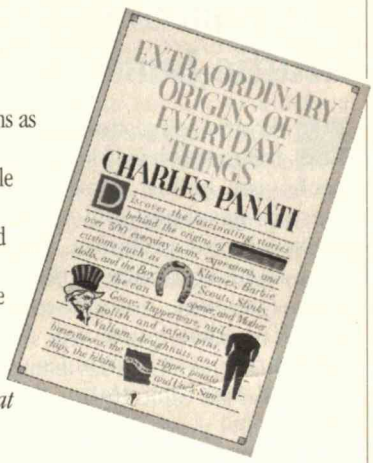


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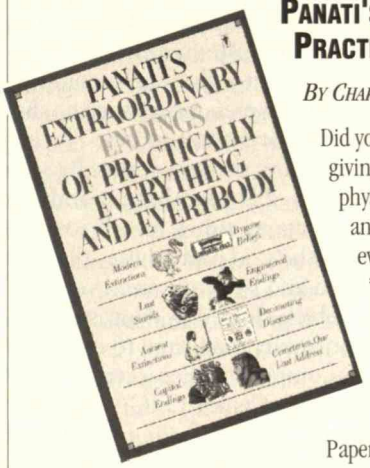


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# Trends

## Outsmarting Traffic Jams

Traffic congestion accounts for more than $100 billion each year in lost productivity, wasted gasoline, and damage caused by air pollution. By the year 2020, according to the Federal Highway Administration (FHWA), that figure will grow even larger as vehicle miles double and resulting traffic delays quadruple.

The good news is that the first round of experiments designed to ease urban traffic congestion using Intelligent Vehicle/Highway Systems (IVHS) is moving forward. In the 20 or so experiments tried so far, a select number of cars that routinely travel given stretches of freeway are typically equipped with systems that advise drivers of congestion ahead and provide rudimentary directions for alternate routes.

But one upcoming experiment in the Chicago area, called the Advanced Driver and Vehicle Advisory Navigation Concept (ADVANCE), promises to propel IVHS technology into the fast lane. Touted as the largest and most complex project of its kind in the nation, ADVANCE is scheduled to begin monitoring a 300-square-mile urban area of highways and arterial streets this summer. As such, it will not only alert drivers to bottlenecks on freeways but also to conditions on a full array of city roads that vary in length, width, speed limit, and the number and location of stop signs and stoplights.

### Computer-Aided Shortcuts

Sponsored by the FHWA, the Illinois Department of Transportation, the Illinois Universities Transportation Research Consortium, and Motorola, the $13 million test will equip some 3,000 cars with computers, CD-ROM drives, display screens, and data-transmission equipment. Each onboard system will also be able to track a vehicle's location by correlating signals received from Global Positioning System satellites with a digital street map in the CD database.

To use the system, a driver enters a destination into the car's computer, specifying any preferences such as shortest distance or no-toll routes. The computer identifies the best course by sifting through a CD database containing expected travel times for all road segments in the grid and advises the driver on screen and by synthesized voice.

If a vehicle slowed by congestion takes an abnormally long time to complete a link, its computer radios a central Traffic Information Center (TIC) and reports the delay. The TIC then notifies the onboard computer of each vehicle heading for that area, which in turn alerts the driver and suggests alternate routes to help avoid the congestion.

Computer models predict that a fully developed system will typically reduce travel time by about 10 percent, says David Boyce, project director and head of the Urban Transportation Center at the University of Illinois. And during extreme conditions it could save much more time. But several hurdles must be overcome before such gains can be realized.

"What if someone stops to make a phone call, drop off some dry cleaning, or pick up a cup of coffee?" says Boyce. "If they don't turn off their engine, the device may not know that they have left the roadway." Commercial drivers, the group that could benefit the most from a traveler information system, could contribute most to this problem, he says. Boyce and his colleagues may install a "pause" button on the ADVANCE console, or program the onboard computer to stop monitoring travel time if the vehicle is idle for more than three minutes.

The price of a system—currently several thousand dollars—could also pose a problem by deterring additional participants from joining the program once the initial test is completed. Motorola contends that costs will drop to less than $1,000 when traveler information systems go from prototype to mass production.

The company also points out that even though no market studies are yet available on how much U.S. consumers would pay for this kind of traveler information system, automobile navigation systems costing between $2,000 and $4,000 are booming in Japan. Motorola is therefore banking that many Americans would be willing to pay as much as $1,000 dollars for a system that could cut their daily commute by 10 percent each way, especially as traffic conditions continue to worsen. The company also expects that commercial transportation services, such as trucking and cab companies, would be willing to equip many of their vehicles with such systems.

Designers of large-scale travel information systems must also find a way to avoid causing a second traffic jam when they route vehicles away from the first. Because IVHS tests so far have involved relatively few vehicles, rerouting has usually been a matter of finding a single alternate route. When many thousands of vehicles participate, the systems must be programmed to disperse them evenly among many routes.

Finally, information on other mass-transit systems needs to be included for routing choices, says Boyce. Commuter rails carry 16 percent of Chicago's citizens to work during rush hour, and is impervious to traffic jams. Future systems should advise travelers of their availability.—*THOMAS KRAWCZYK*



ILLUSTRATION: JON McINTOSH

# Water-Wise Toilets

The common toilet that chugs 3.5 gallons or more with every flush is about to become a relic of our nation's water-wasting past. Since January 1, it has been illegal in the United States to manufacture the old-style toilets found in almost every home in the nation. Manufacturers can now make only low-consumption residential toilets that use no more than 1.6 gallons per flush. And starting in 1997, new toilets for use in business and industry must also be low-flow models.

These requirements are just one part of the Energy Policy Act of 1992, a wide-ranging law intended to promote resource efficiency. Proponents say the law's toilet provisions will reduce not only the amount of water pumped into new homes but also the wastewater that will need to be treated. A family of four using low-flow toilets, for example, will save a whopping 11,000 gallons of water each year.

Such innovations could make a huge dent in the nation's consumption of both water and energy. "The flush toilet uses more water than any other fixture or appliance in the typical home," says William Sharpe, a professor of forest hydrology at Pennsylvania State University. "Forty percent of total water use in the average home is for flushing the toilet." What's more, toilets use drinking water, which must meet strict health standards. In effect, water-guzzling toilets are taking high-quality water and turning it into waste, which then has to be treated to make it clean again.

The law doesn't require homeowners to replace toilets they now have. But because it bans the manufacture of high-flow toilets, homeowners who renovate a bathroom will find only water-stingy models from which to choose. This provision has set the plumbing industry scurrying to devise new designs that will work well enough so consumers won't feel compelled to flush more than once each time they use the toilet.

Toilets have remained pretty much the same since Thomas Crapper, a British engineer, invented them in 1872. The typical design—known in industry circles as the gravity-assisted model—relies on water from a storage tank to run through the toilet bowl and out a hole in the bottom, creating a siphon that pulls waste along with it out the bowl.

### Built for Speed

"To make toilets more efficient, most people think you just have to cut back the amount of water in the bowl," says Peter DeMarco, an engineer at American Standard in Piscataway, N.J., one of the nation's largest manufacturers of toilets and other plumbing fixtures. But when less water is used, the flush loses some of its muscle, and stains frequently remain in the bowl. That explains why Americans tend to spurn European low-flow toilets, which have been around for years, he says, but which don't meet the white-glove standard.

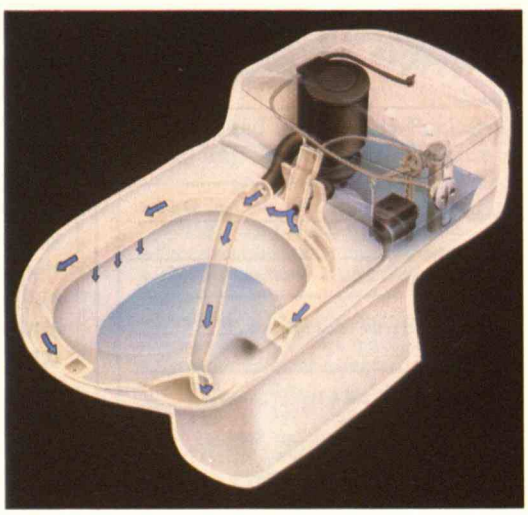
So U.S. manufacturers have given the gravity-assisted toilet a makeover. To help water flow faster, the bowl has steeper sides and contains less water so that the 1.6 gallons flushing down from the tank will have less to push against and will therefore flow faster.

Manufacturers have also crafted pressurized toilets that add extra oomph to the water flowing through the bowl. For example, Kohler Co. of Kohler, Wis., recently unveiled its Trocadero toilet, which incorporates a 0.2-horsepower water pump in the tank. "It is simply plugged into an outlet in the same way a kitchen garbage disposal is plugged in at the time of installation," says a company spokesperson. Because the pump runs for only a couple of seconds during each flush, it would cost a family of four about $1 a year in electricity, estimates John Brown, a senior market analyst at Kohler. By comparison, if the 1.5-gallon toilet were to replace a 3.5-gallon unit, he says, it would save the same family more than 11,000 gallons of water, or about $30, per year.

American Standard's version of the pressure-assisted toilet uses compressed air, stored in a vessel in the water tank, to help whoosh the flushing water on its way. As water fills the water tank, it compresses the air. When a button on the tank is pushed, the air is released, pushing water and waste through the bottom of the bowl and into the sewer line.

Such models would not only save water but also help water-treatment plants, which generally work more efficiently with the more concentrated waste that low-flow toilets would provide, says Sharpe. It's for just such reasons that state and local governments in Massachusetts, New York City, and Los Angeles started mandating low-flow toilets long before the federal government got into the act. Those initiatives—along with the fact that water isn't scarce everywhere—have led critics of the new federal standards to complain that Washington is butting in where it doesn't belong.

"We have plenty of water in certain areas," Ronald Marlenee, then a Republican congressman from Montana, complained to the House of Representatives when the water-conserva-



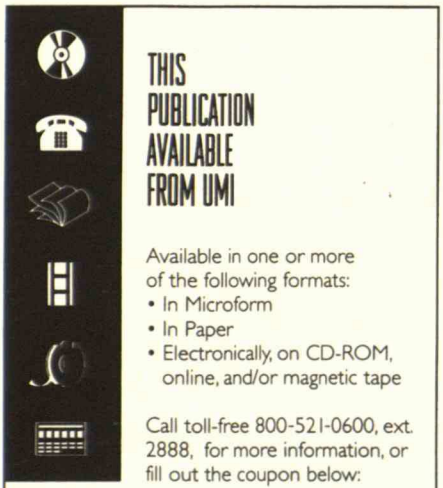
*When standard toilets use less water, they lose oomph for flushing. Kohler's low-flow model compensates by adding steeper sides and a pump to propel water through the bowl.*

PHOTO: KOHLER

tion provisions were debated in 1992. Water-conservation rules should be left to local governments, he said. "I cannot believe that in all seriousness we are on the floor of this House establishing toilet police for the United States of America."

But in the long run, federal standards may be the only way to goad manufacturers into large-scale manufacturing of water-efficient toilets. Without national standards, "we will create a situation where each locality will establish its own standards for energy consumption and water consumption," says Chester Atkins, the former Democratic congressman from Massachusetts who led the fight for water-efficient plumbing. "That will make it impossible to have a national marketplace."

—*VINCENT KIERNAN*

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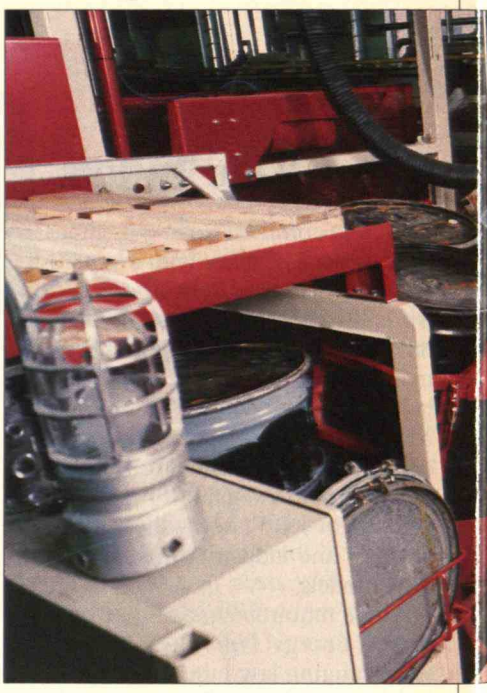
# New Life for Old Paint

If you are like most Americans, chances are you'll find at least a few half-empty cans of paint or stain lying around from your last home-improvement project. In fact, a 1991 survey of 500 households in Vermont found an average of 3.6 gallons of paint in every basement.

The problem is that although most people say they intend to use the paint, most of it gets thrown out. And the chemicals in paint, by any other name, are toxic waste, which is difficult to dispose of. For example, Michael Bender, project coordinator with the Environmental Law Foundation of Vermont (which conducted the household paint survey), says that paint is now banned from the state's landfills. The only legal way for most Vermont residents to get rid of their unused paint (other than finishing that weekend project) is to bring it to one of the state's household hazardous-waste collection centers, which then sends it to a toxic-waste facility for destruction.

Ironically, most of the paint brought to such collection centers—roughly 3 pounds per household per year—is still valuable. With that in mind, Bender established one of the first schemes in the nation for recycling paint. His so-called "drop-and-swap" program, established in Vermont in 1989, took a low-tech but eminently practical approach. "We take in the paint, open the can to make sure that it's still good, and give it out to another resident." The state saves the cost of sending the paint to a toxic-waste facility, and some lucky state resident gets a free can of usable paint.

A few companies in the United States and Canada have been taking the drop-and-swap concept a step further by retrieving paints from municipal drop-off points, blending and reformulating the materials, and selling the resulting mixture back to consumers. Officials at the companies claim it's an innovative, closed-loop way of dealing with a hazard that makes up perhaps half of the household toxic-waste stream.



"We are processing 10,000 packs [45-gallon drums] of used paint per year," says John Langan, who manages paint recycling for the Canadian-based Laidlaw Environmental Systems. Laidlaw has been recycling paint for nearly 10 years, he says, but its capacity dramatically increased in 1992 when it started operating its $3 million facility in Mississauga, Ontario, the only automated paint-recycling plant in the world.

Each can of paint that arrives at Laidlaw is first sorted by hand into light latex, dark latex, light oil, and dark oil paints. The cans are put into one of Laidlaw's automated machines, which extract the liquid, filter it, and test it for chemical contamination. "If there is a detectable presence of PCBs, pesticides, or other hazardous materials, the paint is rejected and set aside for incineration.

What's left is compared against performance specifications for new paint. Laidlaw might have to add fluid to improve the paint's viscosity, titanium dioxide to strengthen its covering ability, or chemicals to control bacterial growth, which is common in old latex formulations. The paint is then shipped off to Laidlaw's partner, Scraf Paints, which blends it to a particular color and sells it as recycled paint through its distribution channel.

PHOTO: LAIDLAW

*Once collected cans of unused paint are sorted by type and color at Laidlaw Environmental Systems, machines extract, filter, and test the contents for chemical contamination.*

A much smaller company that's relatively new to the paint-recycling business, the Massachusetts-based Green Paint Company, collects more than eight different kinds of paint and other coating products, including exterior oil stains, oil-based primers, urethane-reinforced alkyd floor paint, and "stain kill" primer-sealers. The cans are stored in large cardboard bins in Green Paint's Manchaug factory until a few hundred gallons of a particular type accumulate.

### Green, Not Gray

The material is then removed from its cans, blended in large vats, and tested for color and covering ability. If it doesn't meet industry specifications, it is reformulated with more fluids and chemicals. The product is then recanned and sent to Green Paint's retail distributors.

Laidlaw and Green Paint claim that old paint is not only pretty good stuff—both companies boast that their products are higher quality than the average-grade consumer paint made from virgin materials—but it's also attractively priced: recycled paint costs between one-third and one-half less.

Since most of the raw materials come directly from people's basements, companies like Green Paint have an incentive to go into communities and find all those old cans. As such, they're likely to push for improving the number of households participating in hazardous-waste collections, which now hovers between 5 and 10 percent. The key to making municipal collections work, says Scott Herbert, president of Green Paint, is not to let the town do it for the recycler. "If you don't do it yourself, you end up with roof tar and all kinds of things. Our motives are different. They want to get rid of hazardous waste. We want to make a quality paint."

Because paint recycling is so labor intensive, only a handful of companies and cities around the country have tried it. Most of those have simply blended all their collected latex or oil paint into an ugly gray that's not good for much more than covering graffiti.

"The people at Green Paint are different in that they are not just looking for giveaways to housing authorities and departments of public works. They're actually trying to make a profit by selling their paints to commercial painters and, through hardware stores, directly to the consumer," says Barry Connell, a research associate with Dana Duxbury and Associates of Andover, Mass., an environmental consulting firm. The business has also been hailed for its environmental value, as well. This past fall, the Massachusetts Audubon Society awarded Green Paint its highest honor, the Audubon A, for excellence in environmental action.

Right now, companies like Green Paint and Laidlaw are nibbling away at the huge stockpile of old paint in people's basements—estimated to be as high as 14 million gallons in New England alone. Most of the paint industry, which sells some 500 million gallons of new product in the United States each year, still views leftover paint as a problem, says Herbert. But for companies like Green Paint, it's their lifeblood.

—*Simson L. Garfinkel*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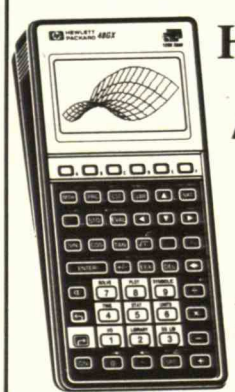

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# Making Music and Movies by Wire

In the duet she sings on Frank Sinatra's latest album, Carly Simon sounds as though she were standing microphone-to-microphone with Ol' Blue Eyes himself in a Hollywood recording studio. Actually, Simon telephoned in her performance from a Boston recording studio. By doing so, she and Capitol Records were spared the expense and inconvenience associated with flying to Hollywood for a day's recording, says Michael Frondelli, director of Capitol Studios.

Making this high-tech conference call possible was Entertainment Digital Network (EDnet), a fledgling San Francisco company that is turning the recording industry on its ear. To the musician and the recording engineer, the network that EDnet creates is almost invisible. The musician performs into a traditional microphone, and the recording engineer works at a customary sound board to control the recording. The difference is that the musician and engineer no longer have to be in the same place.

### Fiber-Optic Phone Links

An EDnet system works by transforming the analog signal from the musician's microphone into digital form—the same way music is stored on a compact disc. The digital signal is then fed into a encoder-decoder device that "compresses" the information, mainly by removing redundant bits of data. The compressed signal is then transmitted over high-capacity fiber-optic telephone lines commonly used by telephone companies to simultaneously carry many long-distance calls. Another encoder-decoder on the receiving end decompresses, or reconstructs, the signal, which is then fed into the recording engineer's headphones and tape recorder.

Data compression causes a slight deterioration in sound quality, but the difference is usually not noticeable to the human ear, says Thomas Scott, cofounder of EDnet. In fact, the quality of sound sent over an EDnet connection is several times better than that of a typical conference call because fiber-optic lines can carry much more data than a standard home or business telephone line, he says.

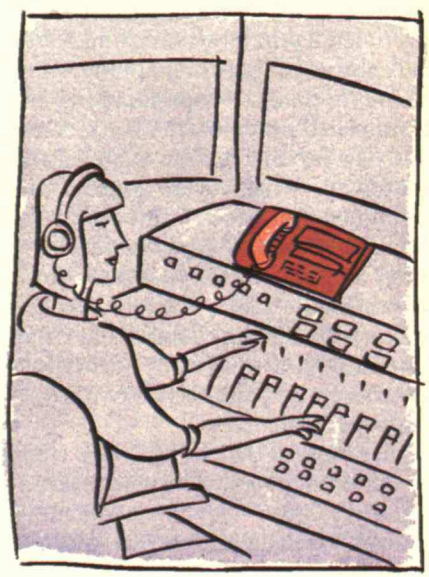
Scott, a winner of two Academy Awards for his sound work on the movies *Amadeus* and *The Right Stuff*, started up EDnet with fellow Hollywood sound engineer Thomas Kobayashi. The two had been working at Skywalker Sound, a high-tech production studio founded by film director George Lucas of *Star Wars* fame. Located hundreds of miles from Hollywood on a ranch near San Francisco, Skywalker Sound had created the initial version of EDnet to solve a vexing problem: how to blend the dialogue, music, special effects, and other components of a movie soundtrack when the director and actors are hundreds of miles apart.

"People in Hollywood are very reluctant to leave the area because they are afraid they won't get their next job, or they'll miss out on lunch with their power agent," says Scott. Sometimes, they are simply not available. For example, Steve Zailian, who directed the movie *Searching for Bobby Fischer*, needed actor Ben Kingsley to rerecord some dialogue long after filming was complete. But Kingsley was in London and Zailian was in Los Angeles.

Instead of flying to Los Angeles, Kingsley went to a London recording studio equipped with encoder-decoder devices and connected by fiber-optic cable to the local phone network. To complete the high-capacity link to a similarly equipped studio in Santa Monica, Calif., EDnet had to route the signal over the fiber-optic networks of eight different telephone companies.

At each studio, identical prints of the movie were mounted on projectors. A special signal transmitted on one audio channel synchronized the two projectors to compensate for the transmission delay of several milliseconds, while Kingsley recited his dialogue on a separate channel.

EDnet and other companies are now moving beyond audio to tackle the more complicated challenge of digital video transmission. As anyone with a laser disc player knows, video images can be converted into digital form just as audio signals can. But the major impediment has been the massive amounts of data needed to reproduce those images. A "broadcast-quality" standard of video, comparable to a network television signal, requires the ability to transmit 90



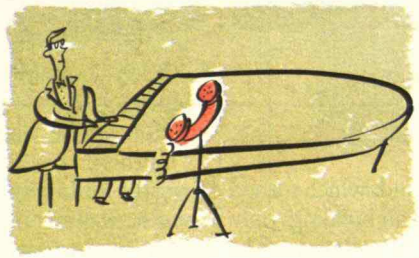


ILLUSTRATIONS: DIANE BIGDA

megabytes of data per second. That is akin to taking all the information stored on a typical home computer and sending it over a telephone line in a second.

With data compression, the video signal can be reduced to 45 megabytes a second without losing quality—an amount that high-capacity fiber-optic lines can handle. Such lines have typically cost thousands of dollars per month, putting them out of reach of all but the largest companies such as banks, insurance companies, and brokerage houses, which need to transmit massive amounts of data every day.

But price is no longer such an obstacle. Last spring Pacific Bell, the major local telephone company in California, began offering its top-of-the-market fiber-optic lines to customers at a steep discount of $850 a month, about one-tenth the usual price. The new rate for what Pacific Bell calls its Advanced Broadcast Video Service is intended to bring high-quality video transmission within reach of dozens of smaller editing and postproduction studios that constitute much of California's huge entertainment and broadcast industry.



During a recent trade show, Pacific Bell showed off the system's capabilities by airing *Bram Stoker's Dracula* at a movie theater. Instead of using a film projector whirring away at the back of the theater, the movie was transmitted over fiber-optic cable from several miles away. Industry officials predict that movies soon will routinely be "broadcast" into movie theaters by telephone. Coverage of many California baseball and basketball games is already broadcast over the telephone network, Pacific Bell officials say, saving networks the expense of setting up portable satellite dishes in a stadium parking lot.

Not all video applications require pristine quality. For those that do not, other technologies take advantage of less expensive telephone lines. For example, an Australian firm called Video Fax makes equipment that allows a user to send or receive a video of up to five minutes in length over a standard telephone line. Although the transmission does not take place in real time—one second of video requires about one minute of telephone time to transmit—the fax recipient can play back the video at full speed once it is received.

The video fax must send highly compressed data, giving the final picture a coarse quality. That's because a conventional line can transmit only 128 kilobytes of data a second—far too slow to send the quantity of data required for a broadcast-quality picture. (The 45 megabytes of data that can be sent in one second over a fiber-optic line take nearly 6 minutes to transmit on a standard line.) Even the best quality fax "looks like a VHS tape that's been run through too many times," notes Peter Barton, a project manager at Video Fax.

But that quality is more than adequate for many uses, and standardized fiber-optic lines are relatively inexpensive and available worldwide. Barton says one Australian advertising agency transmits videos between its Perth and Singapore offices, avoiding days of delays due to mailing time and customs.

Other applications may also prove advantageous. Consider a Chicago advertising agency that is filming a commercial in San Francisco, says Scott. After each day's filming, footage can be transmitted back to Chicago executives by video fax, shaving hours off the standard practice of shipping a tape by an overnight express service. "A producer in one city can evaluate the work of an editor in another," he says. "It's not a broadcast-quality signal, but it's good enough for approvals from the creative person."—*DOUG MCCLELLAN*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# Noninvasive Excavation

Ever since German archeologist Heinrich Schliemann first turned the soil at Troy in the 1870s, researchers studying the remains of ancient cultures have had to accept an unfortunate but unavoidable side effect of their profession: they risk destroying their subject even as they study it. But some archeologists are now beginning to use a quick, comparatively affordable, and nondestructive way to "excavate" a site without ever lifting a spade.

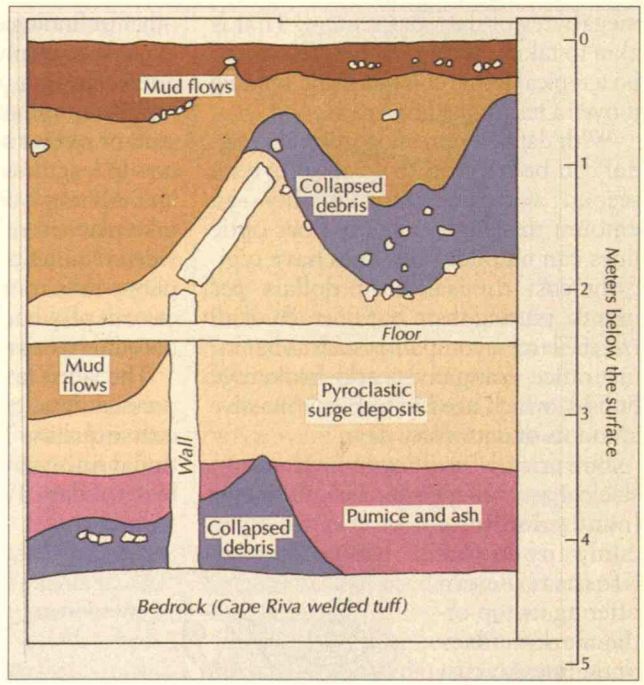
The technique uses ground-penetrating radar (GPR), the same means that engineers have relied on for years to locate underground pipes, toxic-waste barrels, and other objects. Geologists have also used the technology to study natural subterranean formations.

In fact, that's how Floyd McCoy found GPR. A geologist at the University of Hawaii, McCoy had been studying the volcanic past of the Greek island of Thera, now called Santorini, site of one of the most violent eruptions in recorded history. Historians believe Thera's 1628 B.C. blast, thought to pack 10 times the force of the 1980 eruption of Mt. St. Helens, put a swift end to the Minoan civilization. That culture, dominant in the Mediterranean in the Late Bronze Age spanning the seventeenth to mid-fifteenth-century B.C., may have spawned the legend of Atlantis.

Many geologists held that Thera bore a Mt. Fuji-like mountain that disintegrated in the cataclysm. With GPR, McCoy proved that Thera's heart was a plain, not a mountain, and discovered along the way that five previous major eruptions had struck the island over the past 120,000 years.

But the cultural remains that GPR revealed beneath the 2-meter-thick blanket of ash particularly surprised McCoy, turning him overnight into a closet archeologist. GPR pulled back the veil on an entombed town of three-story buildings, paved streets, and elaborate sewer systems.

*At an archeological site in Akrotiri, Greece, geologist Floyd McCoy created this sketch of a building buried by a volcanic eruption 3,600 years ago. He used a system that fires radar into the ground and interprets the reflected signals to generate a crude image of the objects below.*




Archeologists knew the interred village was there. In fact, Greek workers had been excavating Akrotiri, as it is known, ever since they first heard reports of farmer's donkeys suddenly vanishing into large holes in the ground, which turned out to be rooms in Minoan buildings only partially filled by the ash and pumice of the eruption.

But McCoy's GPR data exposed in an instant what only painstaking excavation at enormous cost could have revealed. The radar showed that what was thought to be a village may in fact have been a city—or what Christos Doumas, director of the excavation, proudly calls the "Pompeii of the Late Bronze Age."

"You don't have to dig a trench, you don't have to bring in a backhoe, you don't have to destroy anything," says McCoy, who has been using the system at Akrotiri since 1989. GPR works like the atmosphere-penetrating radar that guides airline pilots and ship navigators.

McCoy uses a unit the size of a coffee table, which is dragged, "by vehicle, mule, or volunteer," he notes, over promising ground. Each nanosecond, the unit broadcasts electromagnetic radiation downward at frequencies ranging from 80 to 500 megahertz. The signals bounce off reflectors below—any materials from a patch of moist dirt to a stone wall that are denser than the surrounding soil—and return to the unit. The system's computer then calculates the depth of the object based on the time delay and prints out a two-dimensional cross section of the area.

Probe depth and image clarity depend on the reflectivity, or density, of the buried materials as well as on the machine's frequency, with higher frequencies offering less penetration but finer resolution than lower frequencies. In dense nonvolcanic soils, the unit is able to produce images of objects about 10 meters down. But in one fine-grained deposit of pure ash at Akrotiri, McCoy set a record for GPR in 1992, penetrating 51 meters.

Interpreting GPR images is a science unto itself. A single boulder or fat root near the surface can obstruct the signal, precluding the view of what's below. Even slight differences in soil moisture can distort the image, and the equipment itself puts out a fair dose of electronic noise. McCoy is therefore careful to verify his findings whenever possible by taking the unit right up to an exposed cliff or excavated trench to corroborate radar images with actual objects.

McCoy has found GPR particularly



DIAGRAM: FLOYD McCOY

effective when operated in tandem with traditional excavation. "At Akrotiri, they've found objects dating all the way back to the Neolithic era," he says, referring to the time around 6000 B.C. when Aegean peoples first started to settle in villages, domesticate animals, and cultivate grains. "But they can't go below the Late Bronze Age surface without destroying this amazing Minoan city. I can use GPR within the excavation to paint a picture of the subsurface right down to the bedrock the whole thing is built on."

Besides dazzling the Greek archeologists at Akrotiri with his colorful images of what they will eventually excavate, McCoy is using GPR to fashion an entire map of the Late Bronze Age island. "I can run around what's left of the island with the radar and find the buried valleys, hills, and plains," he says.

Unfortunately, others less scrupulous than McCoy are also using GPR. McCoy says treasure seekers are using a dozen unregistered, and thus illegal, units in Greece alone to dig up ancient ruins. The most tragic part of such activity is the loss of irreplaceable knowledge about ancient cultures like the Minoan, for as McCoy says dryly, "grave robbers don't publish their results."

Other creative applications for GPR are more beneficial. The U.S. Army now has teams of specialists combing southeast Asia with GPR units, searching the subsurface for unexploded bombs, bodies of American soldiers missing in action, even lost planes and jet fighters, which, as they crash, can bury themselves 30 feet down.

Perhaps the only thing keeping archeologists from leaping into the GPR arena is cost. The system McCoy uses lists for about $120,000. "Given the state of science funding, nobody has that kind of money," says McCoy, who rents his unit in Greece for about $600 a day. Less expensive units are available, but interpretation of their less sophisticated images becomes trickier. When and if costs fall or more research funding becomes available, GPR may someday be as *de rigueur* on a dig as a trowel and brush.—*Peter Tyson*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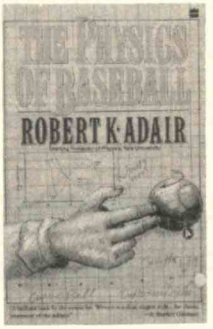


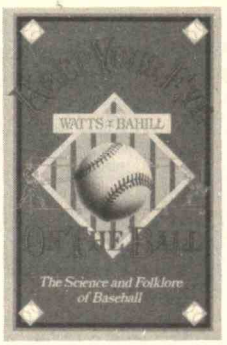


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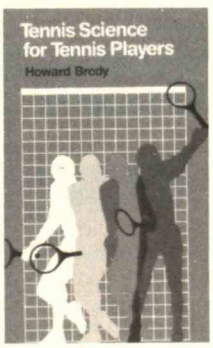


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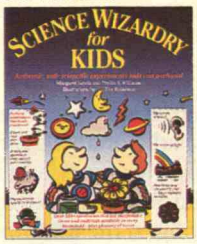


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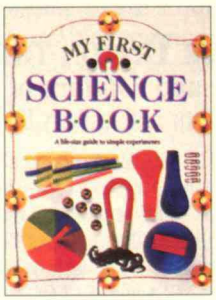


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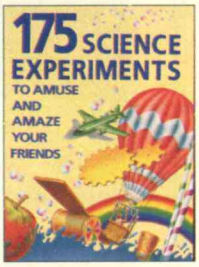


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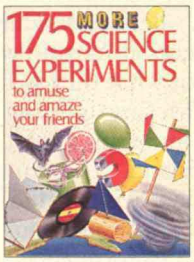


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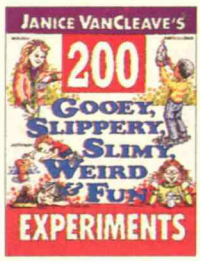


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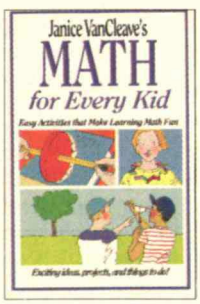


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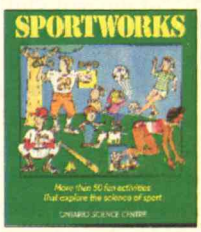


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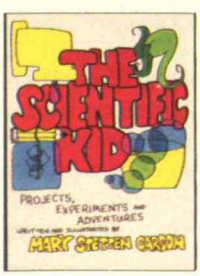


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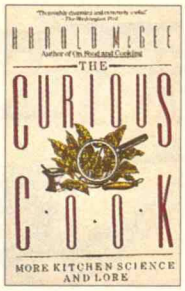


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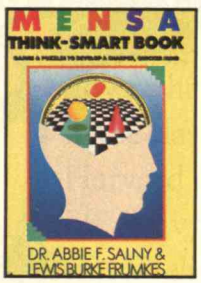


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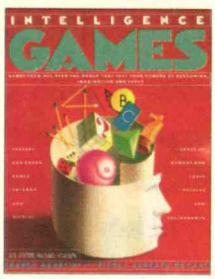


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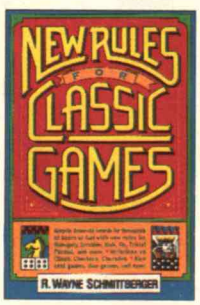


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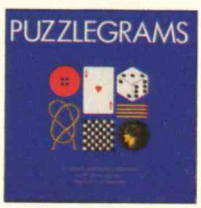


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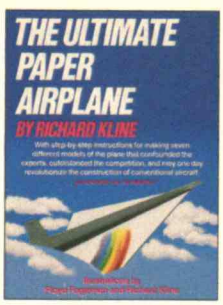


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# Life's Grand Design

By Kenneth R. Miller

**Though some insist that life as we know it sprang from a Grand Designer's original blueprints, biology offers new evidence that organisms were cobbled together layer upon layer by a tireless tinkerer called evolution.**

On January 5, 1982, Federal Judge William K. Overton laid down the law about teaching Biblical accounts of creation in the classroom. Following an extraordinary trial—in which Harvard paleontologist Stephen Jay Gould and other scientific heavyweights argued persuasively that "creation science" was a religious idea that did not meet the generally accepted tests for scientific theory—Overton struck down an Arkansas law that would have mandated the teaching of creationism in the state's public schools. ❧ Such rulings, which invoke the First Amendment prohibition against the state's establishment of religion, have withstood many challenges during the past decade. But the case on creationism is far from closed. Indeed, a new movement is attempting to counter the scientifically accepted theory that living organisms evolved to their present forms. ❧ This time, in contrast to the anti-evolution crusades of the 1980s, advocates of creationism are claiming that their attack against evolution is based on a nonreligious critique of the theory. And this time, rather than aiming at state boards of education and legislatures—where pressure to teach creationism was easily recognized and quickly invalidated by court orders and scientific counterattacks—they are setting their sights on local school boards. ❧ The new strategy seems to be working. Last September, for example, an anti-evolution majority of newly elected members of the Board of Education in Vista, Calif., voted to implement a creation-science component as part of the biology curriculum.

ILLUSTRATION: BLAIR THORNLEY

**INTELLIGENT DESIGN THEORY ARGUES THAT CREATING A COMPLEX ORGANISM THROUGH THE TRIAL AND ERROR OF EVOLUTION WOULD BE LIKE TRYING TO BUILD A PALACE BY ADDING BITS AND PIECES OF MARBLE TO A TOOL SHED.**

Although the science teachers of the district were critical of the decision and their textbook-selection committee flatly rejected a book put forward to support anti-evolution teachings, the board backed down only slightly, instructing teachers to discuss "divine creation" at "appropriate times" in the social-science and language-arts curricula.

Similar actions have been urged upon scores of school boards around the country, and in some districts challenges to evolution have already become part of the standard curriculum. In Louisville, Ohio, for instance, the school board has been directing its teachers since 1986 to present "alternate theories to evolution."

The centerpiece of these attacks against evolution is something that has become known as "intelligent design theory." Quite simply, it states that living organisms are the product of careful and conscious design. A close examination of living organisms, so the argument goes, reveals details of structure and physiology so exquisitely and perfectly formed they cannot be explained by the random workings of evolution.

Scientists are now responding to this theory with a critique of their own. They contend that when closely examined the living world contains evidence that complex organisms not only *could* have evolved through evolution's trial-and-error mechanisms, but *must* have done so because their structure, their physiology, and even their genetic makeup are all inconsistent with the demands of intelligent design.

## The Case for Intelligent Design

Imagine you are walking through the woods and you see two objects, a stone and a pocket watch, lying on the ground. If someone were to ask how long each had existed in its present form, you might say that for all you knew the stone's composition has remained more or less the same perhaps since the earth was formed. But you would not say the same about the watch. As each of its gears, springs, and screws attests, the watch was produced by the conscious design and handiwork of a watchmaker, and watchmakers have not existed forever.

In 1802, Reverend William Paley of Carlisle, England, made this very argument in his book *Natural Theology*. Of course, watches and stones were not the real objects of his interest. He was concerned with a timeless question that still rivets our attention nearly two centuries later: With all its astonishing variety, complexity, and diversity, did life itself have a designer? To Paley, the answer was clear. "There cannot be design without a designer; contrivance without a contriver. . . . The marks of design are too strong to be got over. Design must have had a designer. That designer must have been a person. That person is God."

Paley's writings form one of the most lucid examples of a line of reasoning known as the "argument from design." In various forms, it has served for centuries as a classic argument for the existence of God, and more recently, as an argument against evolution.

The theory of evolution, advanced more than 50 years after Paley by Charles Darwin in his book *On the Origin of Species*, offers a very different explanation for the diversity of living things. In Darwin's world, organisms did not have a conscious, intelligent designer. Instead, their exquisite adaptations and specializations were the products of natural selection, a process whereby the genetic variations—such as in size, shape, and coloration—that gave individuals the best chance to reproduce were passed on to subsequent generations.

Paley's argument for conscious design was well known to Darwin, who answered it effectively, showing that natural selection could account for many of the classic examples of structures and organs that were thought to demand conscious design. But Darwin did not put the argument to rest. In its modern form, the argument now clamors for a place in the science classroom. In fact, a careful summary of the theory is found in the book *Of Pandas and People*, by biologists Percival Davis of Hillsboro Community College in Tampa, Fla., and Dean Kenyon of San Francisco State University. This was the very text rejected by Vista's teachers last fall. Still, it is often put forward as an example of how intelligent design might be placed in a biology class.

The book argues that "in creating a new organism, as in building a new house, the blueprint comes first. We cannot build a palace by tinkering with a tool shed and adding bits of marble piecemeal here and there. We have to begin by devising a plan for the palace that coordinates all the parts into an integrated whole. Darwinian evolution locates the origin of new organisms in material causes, the accumulation of individual traits. That is akin to saying the origin of a palace is in the bits of marble added to the tool shed. Intelligent design, by contrast, locates the origin of new organisms in an immaterial cause: in a blueprint, a plan, a pattern, devised by an intelligent agent."

Of all the arguments that have been advanced against evolution, intelligent design is the most appealing and the

*KENNETH R. MILLER is a professor of biology at Brown University and the co-author of* Biology, *a high-school textbook now in its third edition.*



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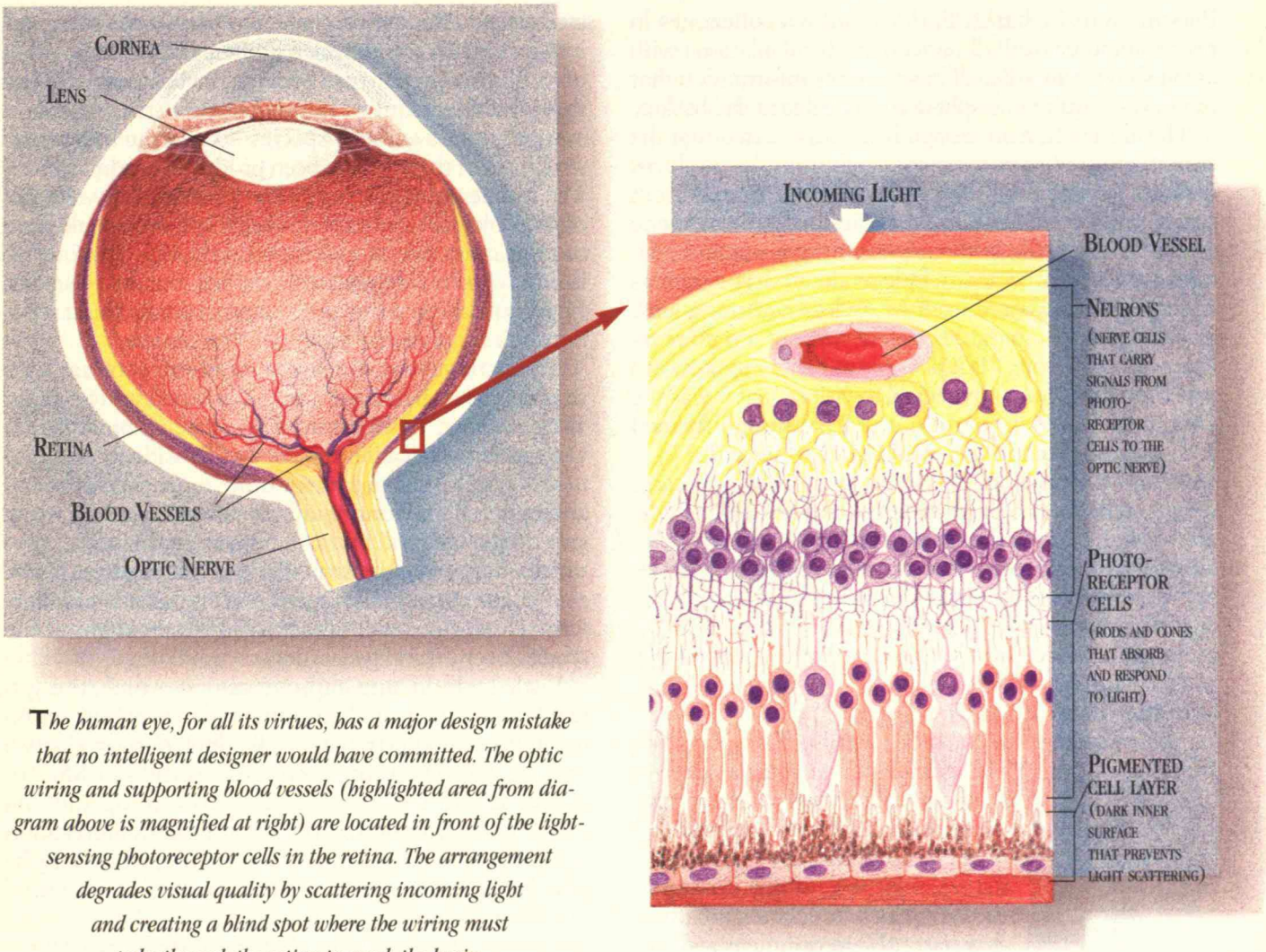



*The human eye, for all its virtues, has a major design mistake that no intelligent designer would have committed. The optic wiring and supporting blood vessels (highlighted area from diagram above is magnified at right) are located in front of the light-sensing photoreceptor cells in the retina. The arrangement degrades visual quality by scattering incoming light and creating a blind spot where the wiring must poke through the retina to reach the brain.*

most effective. The argument is easy to make and easy to understand. It appeals to the emotional idea that we, and other living things, are the result of a conscious process. And most beguiling, the argument seems strengthened by each advance in our understanding of the complexity of life. The grander the palace, the greater the leap that is required to imagine it could have been constructed by "tinkering with a tool shed."

I would not argue, even for a minute, that living organisms are not complex or intricate. In fact, I'd claim that even William Paley underestimated the complexity of living organisms by several orders of magnitude. One case in point is a structure often cited as a perfect example of intelligent design: the human eye. Indeed, the eye is often compared to a camera, clearly an intelligent design, but its capabilities far exceed those of a camera.

The eye, like a top-of-the-line modern camera, contains a self-adjusting aperture, an automatic focus system, and inner surfaces surrounded by a dark pigment to minimize the scattering of stray light. But the sensitivity range of the eye, which gives us excellent vision in bright sunlight as well as in the dimmest moonlight, far surpasses that of any film. Its neural circuitry enables the eye to automatically enhance contrast. And its color-analysis system enables it to quickly adjust to lighting conditions (incandescent, fluorescent, or sunlight) that would require a photographer to change filters and films.

Finally, the eye-brain combination produces depth perception that is beyond the range of any camera. Engineers have yet to design a system that will, for example, calculate the exact force required for an athlete to sink a basket, on the run, from 25 feet away. The

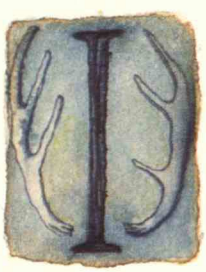
DIAGRAMS: SUE LEE

Phoenix Suns' Charles Barkley and his colleagues in professional basketball perform such calculations with astonishing regularity, all based on the information that their eyes acquire in a split-second glance at the basket.

The argument from design has long asserted that the combination of nerves, sensory cells, muscles, and lens tissue in the eye could only have been "designed" from scratch. After all, how could evolution, acting on one gene at a time, start with a sightless organism and produce an eye with so many independent parts—such as a retina, which would itself be useless without a lens, or a lens, which would be useless without a retina? As Paley himself wrote, "Is it possible to believe that the eye was formed without any regard to vision; that it was the animal itself which found out that, although formed with no such intention, it would serve to see with?"

Complex physiological systems are not the only cases to which the argument from design can be applied. One might well ask whether the careful and precise movements of cells and tissues during human embryonic development or the intricacies of the human genome, with its 6 billion base pairs of DNA encoding an estimated 100,000 genes, do not argue for the role of intelligent design.

### One Improvement at a Time



Intelligent-design advocates contend that evolution could not have produced such complex structures and processes because its instrument, natural selection, simply isn't up to the task. Such advocates do admit that natural selection does a splendid job of passing on preferred genetic traits from one generation to the next. But they do not accept that this "input" into genetic variation, which is often said to be the result of random mutation, can provide the beneficial novelty that would be required to produce new structures, new systems, and even new species. Could the marvelous structures of the eye have been produced just by chance? The simple answer is "no." The extraordinary number of physiological and structural changes that would have to appear at once to make a working, functioning eye is simply too much to leave to chance. But the eye didn't evolve in a single event, and the process of natural selection isn't simply a matter of random chance.

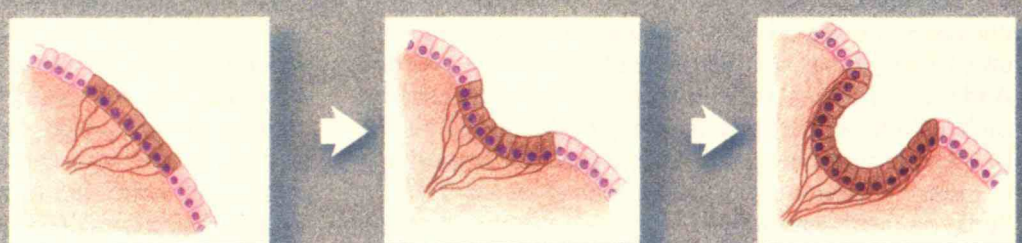
The pathway by which evolution can produce such structures has been brilliantly explained in *The Blind Watchmaker*, by Richard Dawkins, a biologist at Oxford University. The essence of Dawkins's explanation is simple. Given enough time (thousands of years) and material (millions of individuals in a species), many genetic changes will occur that result in slight improvements in a system or structure such as the eye. However slight that improvement, as long as it is genuine, natural selection will favor its spread throughout the species over several generations.

Little by little, one improvement at a time, the system becomes more and more complex, eventually resulting in the fully functioning, well-adapted organ that we call the eye. The retina and the lens did not have to evolve separately, because they evolved together. As Dawkins points out, this does not mean that evolution can account for any imaginable structure, which may be why living organisms do not have biological wheels, x-ray vision, or microwave transmitters.

But evolution can be used as an explanation for complex structures, if we can imagine a series of small, intermediate steps leading from the simple to the complex.

### *Evolution of the eye*

*A complex eye could easily have evolved from a simple eyespot through a series of minor and reasonable variations. When a change conferred even a slight advantage, it would have spread throughout the population over several generations.*



**SIMPLE EYESPOT**
*One or a few cells develop a slight sensitivity to light*

**RECESSED EYESPOT**
*Slight indentation broadens area of light sensitivity*

**DEEP RECESSION**
*Curvature enhances ability to detect location of light*

Further, because natural selection will act on every one of those intermediate steps, no single one can be justified on the basis of the final structure toward which it may be leading. Each step must stand on its own as an improvement that confers an advantage on the organism that possesses it.

This step-by-step criterion can easily be applied to a complex organ like the eye. As shown in the illustration below, we can begin with the simplest possible case: a small animal with a few light-sensitive cells. We could then ask, at each stage, whether natural selection would favor the incremental changes that are shown, knowing that if it would not, the final structure could not have evolved, no matter how beneficial. Starting with the simplest light-sensing device, a single photoreceptor cell, it is possible to draw a series of incremental changes that would lead directly to the lens-and-retina eye. None of the intermediate stages are unreasonable, since each requires nothing more than an incremental change in structure: an increase in cell number, a change in surface curvature, a slight increase in transparency.

This incremental process is the real reason why it is unfair to characterize evolution as mere chance. Chance plays a role in presenting random genetic variations. But natural selection, which is *not* random, determines which variations will become fixed in the species.

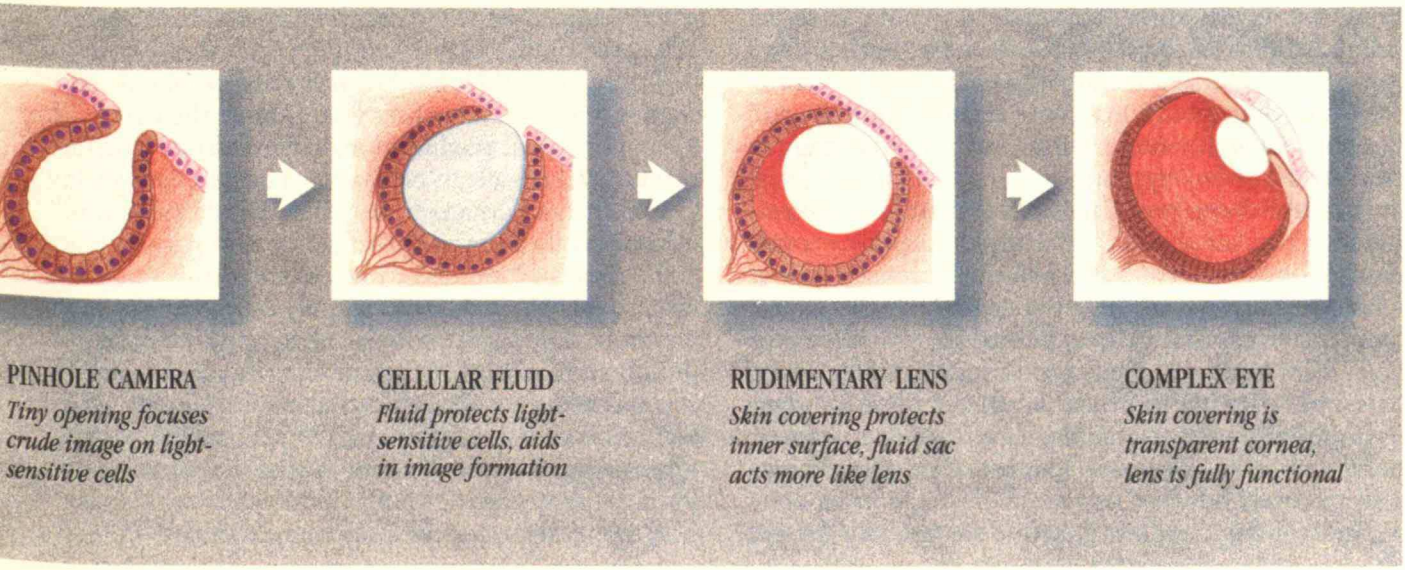
Critics might ask what good that first tiny step, perhaps only 5 percent of an eye, might be. As the saying goes, in the land of the blind the one-eyed man is king. Likewise, in a population with limited ability to sense light, every improvement in vision, no matter how slight, would be favored.

One might rightly point out that if this scenario were really true, then evolution should have driven the independent development of light-sensing abilities in scores of organisms. In fact, in a 1992 review of the evolution of vision, neuroscientists Michael F. Land from the University of Sussex, England, and Russell D. Fernald from Stanford cite evidence that primitive eye-spot light-sensing systems have evolved independently at least 65 times. More complex image-forming systems have also evolved many times, employing roughly 10 distinct image-forming mechanisms. In fact, in a single group, the mollusks, organisms exist with distinct light-sensing systems that correspond to each stage in our hypothetical scheme. Clearly, each of these intermediate steps must be considered reasonable if an organism living today possesses it.

## Flawed Designs

nother way to respond to the theory of intelligent design is to carefully examine complex biological systems for errors that no intelligent designer would have committed. Because intelligent design works from a clean sheet of paper, it should produce organisms that have been optimally designed for the tasks they perform. Conversely, because evolution is confined to modifying existing structures, it should not necessarily produce perfection. Which is it?

The eye, that supposed paragon of intelligent design, offers an answer. We have already sung the virtues of this extraordinary organ, but we have not considered specific aspects of its design, such as the neural wiring of its light-sensing units. These photoreceptor cells, located in the retina, pass impulses to a series of interconnecting cells that eventually pass information to the cells of the



optic nerve, which leads to the brain.

An intelligent designer, working with the components of this wiring, would choose the orientation that produces the highest degree of visual quality. No one, for example, would suggest that the neural connections should be placed in front of the photoreceptor cells—thus blocking the light from reaching them—rather than behind the retina.

Incredibly, this is exactly how the human retina is constructed. Visual quality is degraded because light scatters as it passes through several layers of cellular wiring before reaching the retina. Granted, this scattering has been minimized because the nerve cells are nearly transparent, but it cannot be eliminated because of the basic design flaw. Moreover, the effects are compounded because a network of vessels, which is needed to supply the nerve cells with a rich supply of blood, also sits directly in front of the light-sensitive layer, another feature that no engineer would propose.

A more serious flaw occurs because the neural wiring must poke directly through the wall of the retina to carry the nerve impulses produced by photoreceptor cells to the brain. The result is a blind spot in the retina—a region where thousands of impulse-carrying cells have pushed the sensory cells aside. Each human retina has a blind spot roughly a millimeter in diameter—one that would not exist if only the eye were designed with its sensory wiring behind rather than in front of the photoreceptors.

Do these design problems exist because it is impossible to construct an eye that is wired properly, so that the light-sensitive cells face the incoming image? Not at all. Many organisms have eyes in which the neural wiring is neatly tucked away behind the photoreceptor layer. The squid and the octopus, for example, have a lens-and-retina eye quite similar to our own, but their eyes are wired right-side-out, with no light-scattering nerve cells or blood vessels in front of the photoreceptors and no blind spot.

None of this should be taken to suggest that the eye functions poorly. It is a superb visual instrument that serves us exceedingly well. To support the view that the eye was produced by evolution, one does not have to argue that the eye is defective or shoddy. Natural selection, after all, has been fine-tuning every organ in the body, including the eye, for millions of years. The key to the intelligent design theory, on the other hand, is not whether an organ or system works well but whether its basic structural plan is the obvious product of design. The structural plan of the eye is not.


*The panda's "thumb" is actually a wrist bone that evolved into a stubby protuberance, complete with supporting muscles for gripping and spreading, to help pandas strip leaves from bamboo shoots. An intelligent designer would more likely have modeled a longer and jointed opposable thumb from one of the other five digits, so pandas could handle their food with greater dexterity.*

Evolution, which works by repeatedly modifying preexisting structures, can explain the inside-out nature of our eyes quite simply. The vertebrate retina evolved as a modification of the outer layer of the brain. Over time, evolution progressively modified this part of the brain for light sensitivity. Although the layer of light-sensitive cells gradually assumed a retina-like shape, as the figure on the preceding spread illustrates, it retained its original orientation, including a series of nerve connections on its surface. Conversely, mollusk eyes are wired optimally because rather than evolving from brain cells, which have wiring on the surface, they evolved from skin cells, which retained their original orientation with the wiring below the surface.

The living world is filled with examples of many other organs and structures that clearly have their roots in the opportunistic modification of a preexisting structure rather than the clean elegance of design. Steven Jay Gould, in his famous essay "The Panda's Thumb," makes exactly this point. The giant panda has a distinct and dexterous "thumb" which, like our own thumb, is opposable. These animals nimbly strip the leaves off bamboo shoots by pulling the shoots between the thumb and their other fingers. But the panda's thumb isn't a true digit at all. In fact, the panda grips the shoot of bamboo between its palm, which already has five fingers, and a bone in the wrist that has been enlarged to form a stubby protuberance.

A true designer would have been capable of remod-

**INTELLIGENT DESIGN THEORY CANNOT EXPLAIN THE PRESENCE OF NONFUNCTIONAL PSEUDOGENES IN HUMAN DNA UNLESS IT ALLOWS THAT THE DESIGNER DEVELOPED A BLUEPRINT LOADED WITH JUNK AND SCRIBBLES.**

eling one of the existing digits, like the thumb of a primate, to help pandas hold their food. Evolution settled for much less: a bamboo-gripping pseudo-digit that conferred just enough of an advantage to be favored by natural selection. As Gould himself notes, a single mutation increasing the rate of growth of this wristbone could explain the formation of the panda's thumb. It is a clear case of the way evolution produces organisms that are well-adapted but not necessarily well-designed.

### Hen's Teeth and Hidden Traits

The concept of intelligent design is particularly clear on one point: organisms have been designed to meet the distinct needs of their lives and environments. As such, the master genetic plan should correspond precisely to the organism for which it codes. It should not contain superfluous genes or gene sequences that obviously correspond to structures or substances for which the organism has no need.

But such is not the case. For example, consider "hen's teeth," often referred to as the scarcest of objects. Indeed, hen's don't have teeth, nor do any other living birds. A proponent of intelligent design must maintain that they have not been designed to have teeth, quite probably because the designer equipped them with alternatives (hard beaks and food-grinding gizzards) that are superior for lightweight flying organisms.

Yet in 1980 Edward Kollar and Christopher Fisher, dental researchers at the University of Connecticut, decided to test whether certain cells in the mouths of chickens still have the capacity to become teeth. The scientists took mouse tissue that normally lies just beneath the epithelial cells that develop into teeth and put it in contact with chick epithelial cells. The chick cells, apparently influenced by the mouse tissue, dutifully began to produce impact-resistant enamel that eventually developed into recognizable teeth.

The experimenters took great care to exclude the possibility that mouse tissue had produced the teeth, first by making sure that no mouse epithelium was included in the experiments, and second by confirming that the cells in the tooth-producing tissue were indeed chick cells. Moreover, their experiments have since been confirmed by two independent groups of investigators.

No intelligent design could account for the presence of tooth-producing genes in chicken cells. Indeed, it would be remarkably unintelligent to endow birds with such useless capabilities. Evolution, though, has a perfectly good explanation. Birds are descended from organisms that once had teeth, and therefore they may retain these genes, even if other genetic changes normally turn off their expression. Birds thus have a genetic mark of their own history that no designed organism should ever possess.

### DNA's Evolutionary Clues

Modern genetics allows us to test evolution and intelligent design even further. Rather than depending on the indirect evidence of structure and physiology, we can as never before go right to the source, to the genetic code itself. If the human organism is, indeed, the product of careful, intelligent design, a detailed analysis of human DNA should reveal that design. But if the human genome is the product of an evolutionary history, then DNA should be a patchwork riddled with duplicated and discarded genes, and loaded with traces of our evolutionary past.

Although a complete sequence for all human DNA is at least a decade away, we already know more than enough of that sequence to begin to address the question of design. Let's take, as a representative example, a piece of chromosome 11 known as the β-globin cluster, which produces an important component of hemoglobin, the oxygen-carrying protein that gives blood its red color. This cluster contains genes for five different kinds of β-globin: two are expressed in adults, and three are expressed during an embryo's development. The embryonic forms of β-globin bind oxygen a bit more tightly than adult forms do. (The embryo uses its tight-binding forms to draw oxygen from the blood of its mother; the adult forms need only draw oxygen from the atmosphere.)

Evolution maintains that the multiple, and slightly different, copies of these genes are the result of gene duplication, a random process in which mistakes of DNA replication show up as extra copies of a single ancestral gene. Once the original β-globin gene had been duplicated a number of times, slight variations within each sequence could produce the five different forms of the globin gene, each of which offers specific benefits. Intelligent design proposes much the same mechanism, except that the production of extra copies and their modification to suit the embryo were a matter of intentional design, not the result of chance and natural selection.

Are the five genes of this complex the elegant products of design, or a series of mistakes of which evolution took advantage? The cluster itself, or more specifically a sixth β-globin gene in the cluster, provides the answer.

**EVOLUTION IS NOT INCONSISTENT WITH A BELIEF IN GOD, BUT RATHER MAY BE TAKEN AS PROOF OF THE POWER AND SUBTLETY OF THE CREATOR'S WAYS.**

This gene is easy to recognize as part of the β-globin family because it has a DNA sequence nearly identical to that of the other five genes. Oddly, however, this gene is never expressed, it never produces a protein, and plays no role in producing hemoglobin. Biologists call such regions "pseudogenes," reflecting the fact that however much they may resemble working genes, in fact they are not.

How can we be sure that the sixth gene is really a pseudogene? Molecular biologists know that the expression of a gene like β-globin is a two-step process. First, the DNA sequence has to be copied into an intermediate known as RNA. Then that RNA sequence is used to direct the assembly of a polypeptide—in this case, a β-globin. There is no evidence that the first step ever takes place for this gene because no RNA matching its sequence has ever been found. In fact, the gene lacks the control sequences that precede the other 5 genes on the DNA and signal the cell where to start producing RNA.

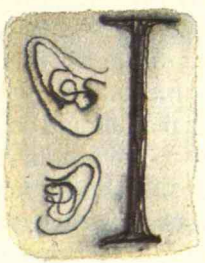
Furthermore, even if its sequences were somehow copied into RNA, the gene still could not direct the assembly of β-globin, or any polypeptide for that matter, since it contains six distinct defects, any one of which would prevent it from producing a functional polypeptide. In short, this sixth gene is a mess, a nonfunctional stretch of useless DNA.

The theory of intelligent design cannot explain the presence of nonfunctional pseudogenes unless it is willing to allow that the designer made serious errors, wasting millions of bases of DNA on a blueprint full of junk and scribbles. Evolution, in contrast, can easily explain them as nothing more than failed experiments in a random process of gene duplication that persist in the genome as evolutionary remnants.

The β-globin story is not an isolated case. Hundreds of pseudogenes have been discovered in the 1 or 2 percent of human DNA that has been explored, and more are added every month. In fact, the human genome is littered with pseudogenes, gene fragments, "orphaned" genes, "junk" DNA, and so many repeated copies of pointless DNA sequences that it cannot be attributed to anything that resembles intelligent design.

If the DNA of a human being or any other organism resembled a carefully constructed computer program, with neatly arranged and logically structured modules each written to fulfill a specific function, the evidence of intelligent design would be overwhelming. In fact, the genome resembles nothing so much as a hodgepodge of borrowed, copied, mutated, and discarded sequences and commands that has been cobbled together by millions of years of trial and error against the relentless test of survival. This jumbled genome works, and it works brilliantly; not because of intelligent design, but because of the great blind power of natural selection to innovate, to test, and to discard what fails in favor of what succeeds. The organisms that remain alive today, ourselves included, are evolution's great successes.

### A Process Set in Motion



It is crucial to recognize the stakes of this debate. Intelligent design theory requires that we pretend to know less than we do about living organisms and less than we do about design, engineering, and information theory. It demands that we set aside evolution's simple and logical explanations for the design flaws of living organisms in favor of a nebulous theory that pretends to account for everything by saying "Well, that's the way the designer made it." In short, it requires a retreat back into an unknowledge of biology that is unworthy of the scientific spirit of this century.

It is particularly unfortunate that the advocates of intelligent design theory seem to see it as a way of countering what they view as evolution's inherent incompatibility with religion. In reality, evolution is not at all inconsistent with a belief in God, a fact recognized by Darwin himself in the concluding passage of *On the Origin of Species*: "There is grandeur in this view of life, with its several powers, having been originally breathed by the Creator into a few forms or into one; and that, whilst this planet has gone cycling on according to the fixed law of gravity, from so simple a beginning endless forms most beautiful and most wonderful have been and are being evolved."

William Paley once hoped that the study of life could tell us something about the personality of the creator. Although Paley was wrong about the argument from design, he may have been right about the notion of personality. To the deeply religious, evolution may be seen not as a challenge but rather as proof of the power and subtlety of the creator's ways. The scope and scale of evolution can only magnify our admiration for a creator who could set such a process in motion. The great architect of the universe might not have written down each DNA base of the human genome, but that architect would still have been very clever indeed. ■

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BY ADRIANE FUGH-BERMAN

# TRAINING DOCTORS TO CARE FOR WOMEN

THE DEBATE OVER A NEW MEDICAL SPECIALTY IN WOMEN'S HEALTH COULD YIELD IMPROVED CARE FOR MALE AND FEMALE PATIENTS ALIKE.

ILLUSTRATIONS BY STEVE MUSGRAVE

IN anatomy courses, medical students are commonly instructed to cut off the breasts of their female cadavers and, without examining them, toss them into the garbage. At my own medical school, which represents the more unenlightened end of the spectrum, students were told that women, unlike men, do not need orgasms for a satisfactory sex life, and that a woman infected with a sexually transmitted disease through her husband should be treated without being informed what she is being treated for. Today my alma mater still does not allow women to examine male urology patients at its own hospital; men, needless to say, routinely examine women patients.

Attitudes absorbed during training affect later medical practice, and not surprisingly, the current medical system remains deficient indeed when it comes to the care of women. Many cesarean sections done in the United States are unnecessary, but because the procedure is better compensated, faster, and carries less risk of a lawsuit than labor, in some hospitals half of all deliveries are surgical. Similarly, episiotomies, the cuts made to extend the vaginal opening during labor, are seldom needed, but because they ease the doctor's job they are standard operating procedure and remain the painful bane of the post-partum mother.

Unnecessary hysterectomies are epidemic as well, having been performed on a third of women under fifty and half of women over that age. The most common reason is the presence of fibroids, benign growths that generally can be taken out without removing the uterus. Surgical beautification for women is also popular: in the early 1980s the American Society of Plastic and Reconstructive Surgeons reached a new low when it suggested that small breasts be considered a disease—they named it "micromastia."

On the institutional level, women have been all but ignored. It was only in 1991 that the Centers for Disease Control, now the Centers for Disease Control and Prevention, acknowledged that AIDS in women could manifest as cervical cancer, pelvic inflammatory disease, or chronic vaginal yeast infections. Before then, AIDS criteria were based only on how the disease manifested in men, so that many women were denied public assistance earmarked for AIDS patients. Women who are injured on the job also receive fewer benefits than men; for example, although women miss more days of work because of back pain, they receive only 25 percent of workman's compensation for that problem.

Medical research is another area where women need to be better represented. For instance, although drugs are given more often to women, until a few years ago drug trials were performed exclusively on men. The Physician's Health Trial, which found that small doses of aspirin reduced cardiovascular deaths, included 20,000 men and no women. But substances do not always have the same effect on both sexes. A case in point is estrogen, which is thought to protect women against cardiovascular disease, since the rate of such disease rises after menopause. This theory led to a particularly misguided study in which men were given estrogen—the experiment had to be terminated abruptly because cardiovascular disease among the subjects was actually increasing. Risk factors and diseases themselves may also manifest differently in men and women. Total cholesterol levels over 200 increase cardiovascular risk in men, but an analysis of the small numbers of women in cardiovascular risk-factor trials has found that total cholesterol is not an independent risk factor for them until levels reach 260. Scant attention has been paid to such findings.

Fortunately, interest in improving women's health care has never been higher. The National Institutes of Health established the Office of Research on Women's Health in 1990, the *Journal of Women's Health* has been in existence for almost two years, and reports of gender discrimination in the treatment of cardiovascular disease and AIDS have heightened public awareness of women's problematic relationship to the health care system. Another encouraging sign is that 40 percent of this year's entering medical school class is female. "As more women enter medicine, dentistry, and osteopathy, there has been a growing demand for increased educational opportunities in women's health," states Anne Wentz, an obstetrician-gynecologist and editor of the *Journal of Women's Health*.

But just how should doctors be trained to care for their female patients? The issue is controversial. Fellowships, residencies, master's programs, and continuing education courses in women's health have all been proposed, and in some cases implemented. No proposal, however, has drawn more fire than the recommendation that a new medical specialty in women's health be established—some of the most outspoken women in medicine are on opposite sides of the question. And while the fact is that advocates of the specialty may never achieve exactly what they envision, the debate itself is focusing the thinking of today's physician activists. It may even have a substantial impact on medicine in general, since the philosophy behind a women's health specialty, which emphasizes treating the patient as a whole person and establishing a partnership between patient and physician, is something that many people, men and women alike, are eager to learn how to put into practice.

## Creating a Pool of Experts

Karen Johnson, a psychiatrist in San Francisco who has led the battle for a women's health specialty, wants to establish a multidisciplinary approach that would avoid having the female body "arbitrarily divided among specialists." Under the current system, she points out, a man has just one primary physician, while a woman has two—an internist for a physical and a gynecologist for a Pap and pelvic—who usually have little insight into each other's domain. Training in internal medicine rarely includes office gynecology, and although internists regularly examine male genitalia, not all do a Pap smear or a pelvic exam as part of a routine checkup. As for obstetrician-gynecologists, they typically have a minimal background in internal medicine. "Ob-gyn is a surgical specialty," says Charlea Massion, a Santa Cruz family practitioner with a focus on women's health. "A shift in emphasis would take more than tacking on a few months of primary care to their training."

Such fragmentation, which is troublesome enough when a woman is healthy, quickly becomes difficult to manage once her health begins to fail. Johnson notes that someone with endometriosis, for example, may see her general practitioner for pain control and bowel or bladder complications and her gynecologist for hormonal or surgical intervention. On top of this, she may consult a psychiatrist for sexual dysfunction and corollary distress.

Thus residents in a women's health specialty would receive extensive training in internal medicine, office gynecology, and psychiatry, and would also learn about endocrinology, nutrition, orthopedics, and sports medicine. While Johnson's original proposal excludes

*ADRIANE FUGH-BERMAN is medical advisor to the National Women's Health Network and medical director of the Taoist Health Institute in Washington, D.C. She writes frequently on issues in women's health.*

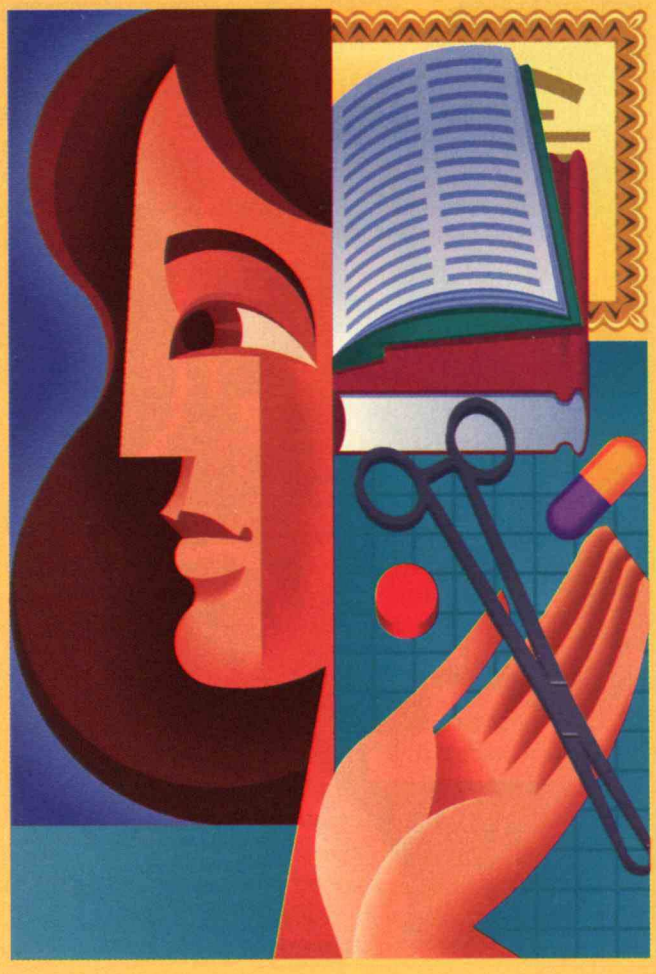
obstetrics, some physicians have suggested that this could be an "option" within the specialty. "It could be like family practice, where everyone gets three to four months of obstetrics in training, and has the option to include it in practice later," explains Massion. Many family practitioners do not do obstetrics, some out of personal preference to sleep nights, others out of concern over malpractice rates, which are not pro-rated for part-time birthers: delivering one baby a year costs as much in insurance as delivering a thousand. On the other hand, some family practitioners, especially rural ones, see obstetrics as a vital part of their work, and a significant number undergo additional training so that they can do cesarean sections and handle complicated births. Specialists in women's health would no doubt have much the same reasons for including or excluding obstetrics.

Johnson's hope is that the status of a specialty will improve conditions for women by creating an identifiable pool of experts from which doctors in other specialties will learn. After all, specialty research does get disseminated to overlapping fields. For instance, although emergency medicine has become a specialty, with its own journals, national conferences, and research agendas, other doctors still staff emergency rooms. The difference is that standards are set by those who specialize in emergency medicine.

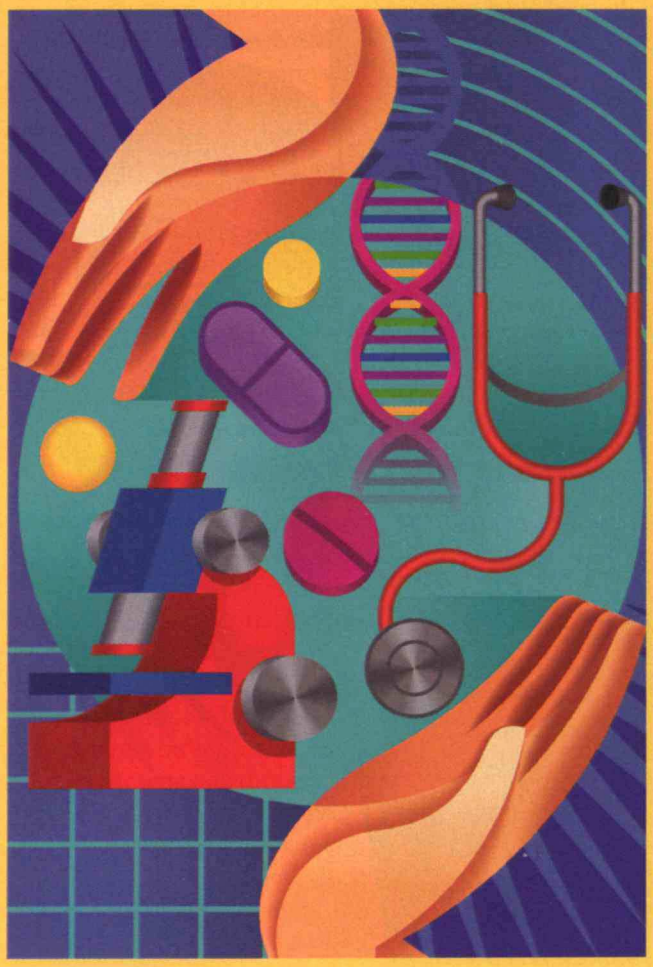
In other words, the last thing Johnson wants for women is an isolated enclave in medicine. Rather, the new specialty would, in her view, pave the way for embedding women's health training into all phases of medical training. "Comprehensive women's health care must have people at every level of the hierarchy trained in women's health care," she says. "It is from the power base of a residency in women's health that efforts to mainstream are most likely to be successful."

Sue Rosser, professor of family and preventive medicine and director of women's studies at the University of South Carolina, agrees. She compares the struggle for a women's health specialty to the one that arose in the 1970s when academics were trying to decide whether they should try to establish new, interdisciplinary women's studies departments or incorporate women's studies scholarship into existing disciplines. And she notes that the most successful institutions used both approaches; those that pursued one or the other had little impact on the broader curriculum. Thus the best route to change would be to create a new specialty in women's health and integrate the knowledge it produces into traditional medicine.

According to Massion, women may not be the only people who stand to gain. "Maybe as a women's health specialty develops, useful information will come out of it about a new model of primary care that will benefit men, too," she suggests. Part of the reason has to do with the interdisciplinary nature of the proposed specialty. "The model is of human medicine as opposed to the biomedical



A SPECIALTY IN WOMEN'S HEALTH OFFERS A MODEL OF PARTNERSHIP BETWEEN PATIENT AND PHYSICIAN THAT OTHER MEDICAL FIELDS MIGHT ADAPT.



CRITICS OF THE PROPOSED SPECIALTY WARN THAT IT COULD SANCTION THE MAINSTREAM'S LACK OF ATTENTION TO WOMEN.

model. The coronary bypass is a biomedical model answer to coronary artery disease. Nutrition and exercise are considered lowly concerns, best left to the nurses. But these factors are principal things we need to do to decrease morbidity and mortality. It's not more coronary artery bypass grafts and dialysis that we need."

Johnson and her colleague Laurel Dawson, an internist who practices at the Bay Spring Women's Medical Group in San Francisco, point to another aspect of the new specialty that could help both sexes. "The concept of women's health has been shaped by consumer activism," they write in the *Journal of the American Medical Women's Association*. "It implies a commitment to prevention, patient education, and information exchange."

Many men are committed to the same things, of course, but women have a substantial history to draw upon—mainly the women's health movement of the sixties and seventies, when women opened feminist health centers, established the National Women's Health Network, demystified gynecological exams by learning how to look at their own cervixes, and redefined their relationships with their bodies and their health care practitioners by writing *Our Bodies, Ourselves*. Even if the current medical system still provides inadequate care for women, these accomplishments undeniably had an impact on the dynamic between doctors and patients, no matter what their respective sexes. "I certainly have male patients who sought out a woman physician because they like the partnership model: an alliance with a physician who helps the patient consider the options," Massion notes. A specialty in women's health could further develop the partnership model, and doctors in other fields might readily adapt it.

## The Danger of Marginalizing Women

Marcia Angell, a pathologist and executive editor of the *New England Journal of Medicine*, is skeptical of all this. A specialty in women's health "would marginalize the care of women and leave the mainstream to men, where the lack of attention to women's health would then be officially sanctioned," she writes. And she has company. "If it were suddenly discovered that doctors weren't being nice to men, we wouldn't say that men need their own specialty," argues New Jersey psychiatrist Michelle Harrison. "We would say that medicine has to change to bring men into the system. There is no aspect of this new proposed specialty that should not be an integral part of the education and practice of every physician, male or female. I want every cardiologist to know about the effect of the menstrual cycle on palpitations. I want every orthopedic surgeon to take women's complaints seriously."

Harrison's feeling is that the two sexes have more in common than not and that to set up a whole new spe-

cialty devoted to women is to define women as different—which is a mistake. "The more you define women as different, the more you get the medical student who was told by the chair of her psychiatry department that all violent crime committed by women is committed when they're premenstrual."

Harrison favors a broader approach to improving care for women. "We're asking the wrong question," she states. "Rather than saying 'Should some physicians specialize in women's health?' the question should be 'What model of women's health best meets the needs of women as patients?'" She proposes a revamping of specialties in which internal medicine would include routine office gynecology, and obstetrics-gynecology would be a referral specialty for reproductive disease and obstetric and gynecologic surgery. Normal births could be handled by midwives, family practitioners, or obstetricians. Like Massion, she finds it troubling that ob-gyns, whose training is primarily surgical, are entrusted with so much of women's health care. "Hormones affect the function of internal organs and should be in the territory of internists," she says. "Why are surgeons prescribing birth control pills?"

Another of Harrison's ideas is a master's-level program in women's health that would draw from nursing, public health, psychology, sociology, and health policy, among other fields. Such a program would be comparable to one in medical ethics, in that it would attract a range of people who would then bring the perspective of the discipline back to their own profession. "We must go beyond the very limited field of medicine," she notes. "Epidemiologists working on women's health could do a lot more good than clinicians working on patients." Her reasoning is that since so little is known about the causes and patterns of disease in women, research into such matters, which is the province of epidemiology, could identify the best means of prevention and treatment.

Harrison also believes Johnson and her colleagues are overlooking key areas of potential that already exist within the current medical system. She points out that physician assistants, nursing advanced practitioners, and nurse-midwives can provide effective primary care and that their training emphasizes a wellness model, psychosocial issues, and education and communication—all things that advocates want to emphasize in a women's health specialty. In her view, the best course is to take advantage of these strengths instead of trying to reinvent them outside the mainstream. Alice Dan, director of the Center for Research on Women and Gender at the University of Illinois, Chicago, agrees. "A women's health focus has been available within nursing training for a long time," she says.

## A Glimpse at the Future

In the midst of such debate, at least three training programs in women's health have sprung up, providing a glimpse of what a new specialty might look like. Brown University School of Medicine is offering a two-year women's health fellowship, to be completed after a primary care residency. Fellows rotate through sessions on mammography, endometrial biopsy, medical consultation during pregnancy, and colposcopy (examination of the vagina and cervix with a lighted magnifying device). They also complete a research project. The current fellow is surveying patients about their interactions with doctors on menopause, as well as looking for ways to improve access to mammography and cervical-cancer screening in low-income communities.

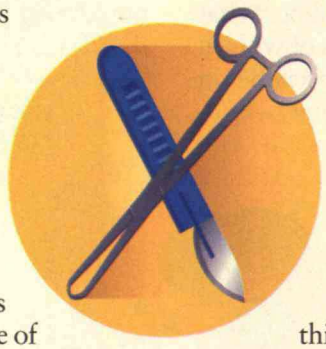
At the University of Pittsburgh, the Department of Internal Medicine offers a women's health track, directed by Michelle Roberts, an endocrinologist and assistant professor of internal medicine. The three interns who started the track in 1993 will rotate through McGee Hospital, a women's hospital, instead of the Veterans Administration hospital, with its overwhelmingly male population. The interns' rotations will also include clinics in breast disease, reproductive endocrinology, osteoporosis, adolescent medicine, colposcopy, women's gastrointestinal problems, and urogynecology.

The Albert Einstein College of Medicine in New York is now seeking interns for a residency in women's health that will begin in July 1994. Director Pamela Charney, associate professor of medicine and assistant professor of ob-gyn, reports that the new program will focus on general internal medicine, health promotion, primary gynecology, disease prevention and epidemiology, psychology and psychiatry, and the care of medical problems in pregnancy. Residents will work in a women's health center as well as a regular internal-medicine clinic, and will spend blocks of time focusing on specific areas of women's health.

Other institutions are also turning their attention to women's health, though they offer only courses rather than full programs. This spring, Yale will launch courses for both undergraduate and medical students. Topics will include sexuality, fetal rights, domestic violence, breast cancer and menopause issues, and the lack of women in clinical trials. Janet Henrich, associate professor of internal medicine and co-director of the courses, intends to incorporate women's health issues into the curriculum at all levels. She would like to see an on-campus center that would bring together faculty in medicine, epidemiology, and public health with students and residents interested

in conducting research on women's health. At Dartmouth, a women's health rotation has been available to medical students and residents for the past two years. So far, six women have gone through this rotation, which is directed by Margo Krasnoff, assistant professor of medicine at the Dartmouth-Hitchcock Medical Center; the first male recruit starts this spring.

The American Medical Women's Association has created an advanced curriculum in women's health that made its debut in New York this fall as a continuing education course for primary-care physicians. More than 250 signed up. Lila Wallis, clinical professor of medicine at Cornell University Medical College and past president of the American Medical Women's Association, chaired the task force that developed the curriculum and is the director of the course, which is organized according to five phases of a woman's life cycle: girlhood (up to the age of 18), young adulthood (19 to 39), midlife ages (40 to 64), mature ages (65 to 79), and advanced ages (80 and up). The course this year will cover midlife and mature women "since the baby boomers are starting to reach menopause," says Wallis. The early and late years will be covered in the second half of the course, to be given in 1994. Among the topics will be sexuality, mental health, violence, health maintenance, and normal and abnormal physiology. Instruction will be provided in procedures such as endometrial biopsy and cervical screening, and in ways of performing painless, competent breast and pelvic exams.



Finally, Rep. Nita Lowey (D-N.Y.) is sponsoring the Women's Health and Medical School Curricula Bill. This legislation, viewed as a first step toward ensuring that all medical students receive training in women's health, would direct the Department of Health and Human Services to study and detail the content of women's health curricula, identify omissions, and offer recommendations to correct inequities. It is part of the omnibus Women's Health Equity Act of 1993, which includes more than 30 bills meant to improve health care research and services to women. All but four of the bills have been introduced and will be considered by the House of Representatives this spring.

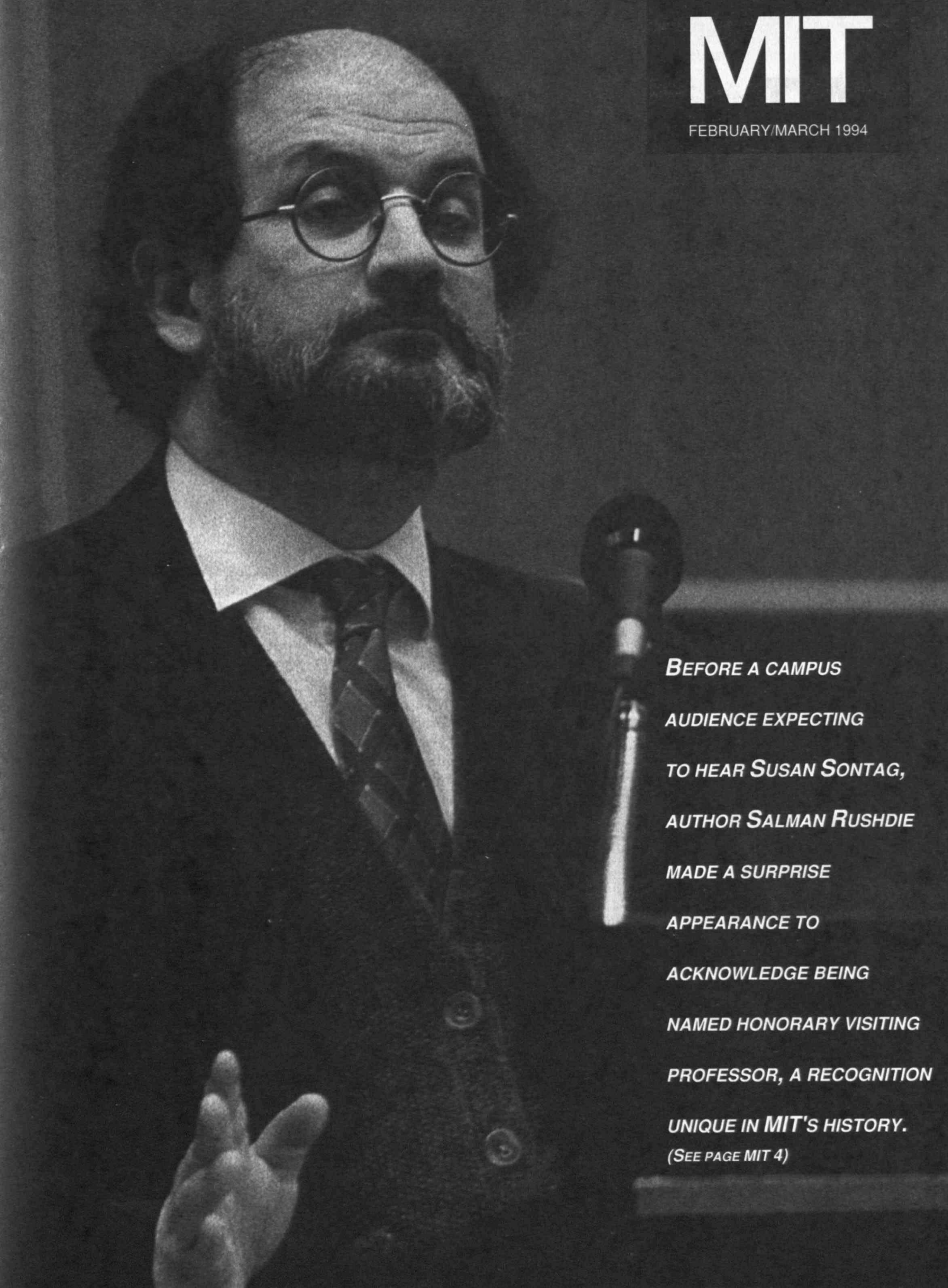
But whether such action will lead to implementing a women's health specialty is still an open question. The American Board of Medical Specialties (ABMS) lists 24 medical specialties; the last one approved was medical genetics in 1991, and the one before that was emergency medicine in 1979. A proposed specialty must prove that it represents a distinct new field. Also, training programs of some sort must already exist. There's a case to be made for the idea that women's health represents a distinct field, and the Brown fellowship and the women's health tracks at University of Pittsburgh and Albert Einstein College of Medicine should qualify as training programs.

Practically speaking, however, any new specialty also needs to be backed by "any existing specialty whose toes it treads on," as psychiatrist Barbara Schneidman, associate vice-president of the ABMS, puts it. First a liaison committee composed of members of the American Medical Association and the ABMS decides whether the request is valid, and then it must be approved by the decision-making bodies of both organizations. A women's health specialty probably would not survive such a process, having drawn clear opposition and no broad-based support.

Interestingly, even some of the pioneers of the training programs in women's health are lukewarm about a new specialty, voicing reservations that sound much like Michelle Harrison's. "Women already face inequity in access to medical careers, and a new specialty would confound this," says Yale's Henrich. "Women may be herded into this specialty instead of having equal opportunity in all disciplines. Also, other physicians may feel that they can abrogate responsibility for women." Internist Anne Moulton, who directs the Brown fellowship, agrees: "The new specialty overlaps with many other specialties, and those in other fields may feel they no longer need to take responsibility for overlapping areas." The American Medical Women's Association has taken no official position on a women's health specialty. The organization is simply committed to ensuring that physicians are capable of meeting the needs of women patients.

Yet even if a full-fledged specialty is unlikely, a subspecialty—something like pediatric radiology, presented under the wing of an existing full-fledged specialty—is still a possibility. Internal medicine might be the friendliest specialty under which to organize, and that might well happen in a few years, when graduates of the new training programs in women's health break double digits and start calling for certification.

Karen Johnson, for one, is open to the idea. "While my ideal would be to have a freestanding women's health specialty, a women's health track in internal medicine or family practice would be fine," she says. She is even open to the idea of ob-gyn expanding its focus to include other aspects of women's health care. "Maybe the American College of Obstetricians and Gynecologists could become the American College of Women's Health," she suggests, pointing out that a similar shift occurred in 1971, when the American Academy of General Practice became the American Academy of Family Physicians. Perhaps it will all come about: the residency, the master's program, the required course in medical school, the collaborative efforts with other professions. But even if it doesn't, the larger aim—that of concentrating attention on women's health issues—can still be on the agenda. ■



# MIT

FEBRUARY/MARCH 1994

*BEFORE A CAMPUS AUDIENCE EXPECTING TO HEAR SUSAN SONTAG, AUTHOR SALMAN RUSHDIE MADE A SURPRISE APPEARANCE TO ACKNOWLEDGE BEING NAMED HONORARY VISITING PROFESSOR, A RECOGNITION UNIQUE IN MIT'S HISTORY.*

*(SEE PAGE MIT 4)*

MIT
FEBRUARY/MARCH 1994

# UNDER THE Domes



*COVER:*
***"This is the first academic honor I've ever received," author Salman Rushdie told his MIT audience, "so it's nice to start at the top." Speaking on that occasion, Alan Lightman, head of the MIT Program in Writing and Humanistic Studies, observed that "Independence of thought is the most precious gift we can give to our students. Tonight we honor a great writer, and we honor ourselves." Rushdie's novel,* Midnight's Children, *was named in 1992 by the Booker Prize committee to be the best novel by a British author in the past quarter century.***
***Photo by Donna Coveney***

## Youths Convicted in Raustein murder

Two of the Cambridge youths accused of murdering Norwegian aeronautical engineering major Yngve Raustein, '94, in September 1992, have been found guilty and sentenced. Shon McHugh, 16, was tried as juvenile and received 20 years in prison, and Joseph Donovan, 19, was given a life sentence. Both men were convicted of felony murder and armed robbery.

A third defendant, Alfredo Velez, 19, negotiated a plea bargain in return for testifying in the McHugh trial and received a seven-year term for manslaughter.

Raustein had been walking with a friend along Memorial Drive at the time he was stabbed. His murder was a source of considerable anguish on the campus and in the Cambridge community. The Middlesex County District Attorney's Office and MIT arranged for Yngve's parents and brother to travel from their home in Os, Norway, to Cambridge for the trials.

In acknowledgement of Raustein's dream of returning from his studies at MIT to launch a space program in Norway, Colonel Kenneth Cameron, '78, carried a small Norwegian flag on a mission of the shuttle *Discovery* in April of last year. The flag, which had hung in Yngve's dormitory room, was later presented to his family. □

***A candlelight ceremony on the steps of the Stratton Student Center was one expression of the MIT community's shock and grief at the murder of Norwegian aeronautical engineering student Yngve Raustein, '94, in September 1992.***

## Independent Residence Development Fund Launches Campaign

Students, alumni/ae, and Institute administrators have long recognized that the Independent Living Groups are more than an essential component of MIT's program to house undergraduates. The ILGs include fraternities, sororities, and a number of non-Greek houses, all operated by their residents and alumni/ae boards. And in addition to providing meals and a roof, they also enable students to build supportive communities and develop valuable life skills.

Dating back to the establishment of Number 6 Club and the Alpha Theta chapter of Sigma Chi in the late 1880s, the ILG system predates the first dormitory, Senior House, by more than 25 years. Since the mid-1950s, the ILGs have housed roughly a third of MIT's undergraduates. Following the Second World War, however, when MIT was building modern dorms, the fraternity houses in the Back Bay were deteriorating. It was clear that the ILGs would need help if they were to continue to meet the expectations of incoming freshmen, parents, and the Institute.

So in 1963, MIT established the Independent Residence Development Fund (IRDF) to provide financial help while preserving the ILGs' ability to run their own affairs. From alumni/ae contributions earmarked for this purpose and



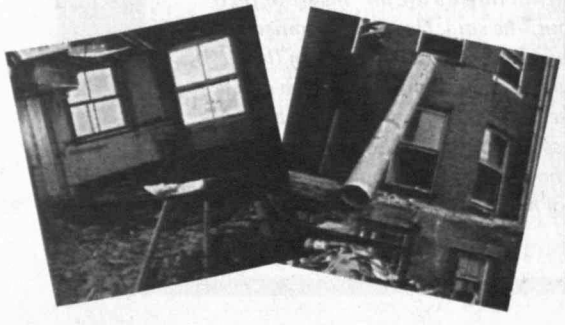
PHOTO: MICHAEL FRANKLIN

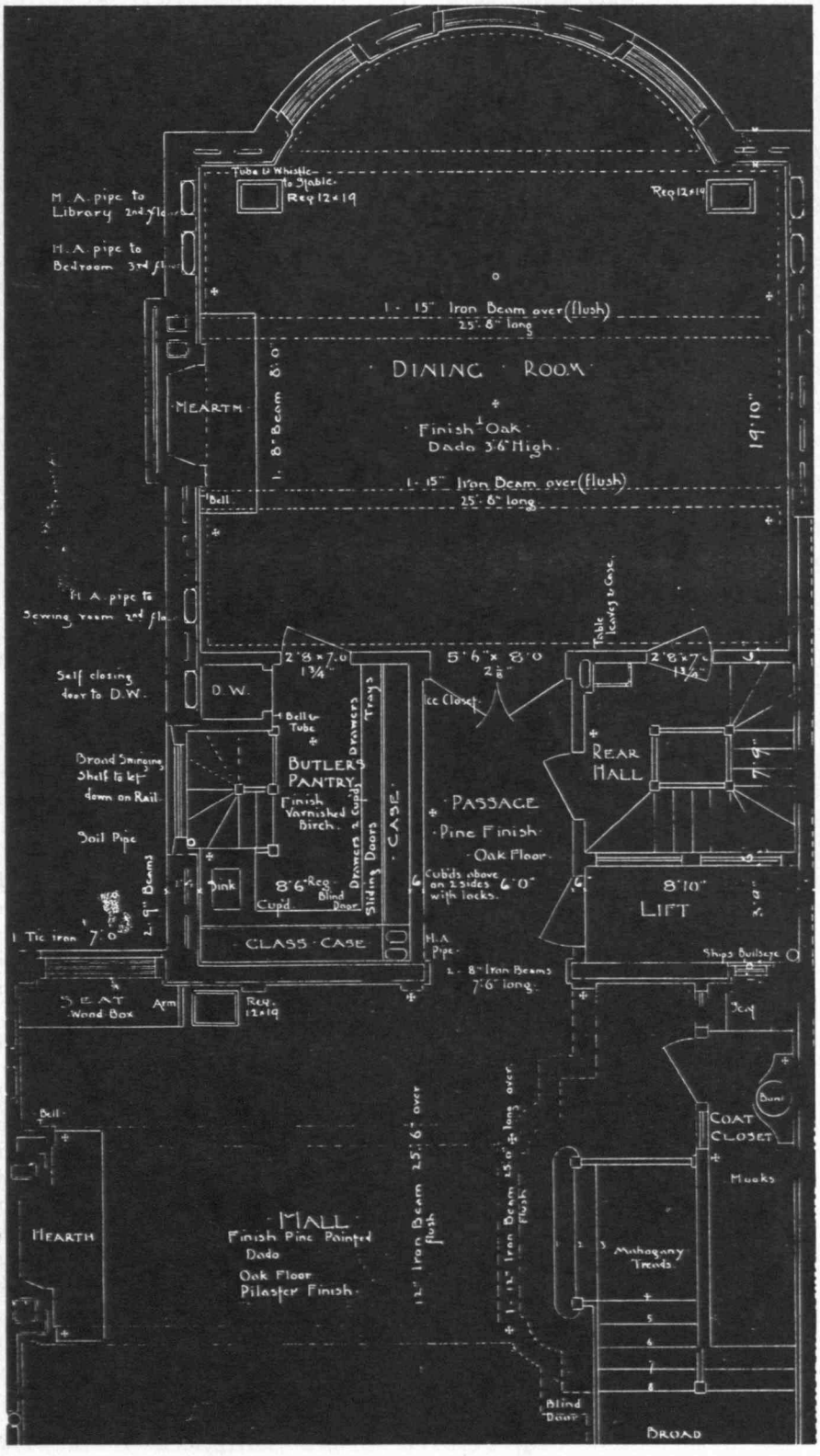
dispensed through a Board of Allocation, the IRDF would make loans for the acquisition, maintenance, and improvement of houses. The borrowers would be charged only 3 percent interest and could amortize the loans over a number of years, with the conditions of each loan tailored to the financial situation of the living group. (Historically, loans could be for as long as 40 years; but the current maximum is 25 years.)

The IRDF Allocation Board is made up of ILG alumni/ae. Board members are not provided with information about the names of donors or size of contributions, and they make their loan decisions solely on the basis of sound proposals and demonstrated need. The loan applications are typically well thought-out, says Lindsay Russell, '50, who has been a member of the Allocation Board since its inception, and very seldom does the board have to turn anyone down. "Our only reason in the past [for turning down a loan] was because the fraternity in question had sufficient liquid assets of its own," he said.

The IRDF is unique, as is MIT's support for its independent residence system, says Neal Dorow, assistant dean

***As long as Delta Tau Delta members had to hire a contractor to bring their house up to MIT's new safety codes, they saw that it was a good time to remodel their kitchen (shown in process below) and carry out other renovations, all with the help of a loan from the Independent Residence Development Fund.***






PHOTOS: MARK LANDSBERG & ASSOCIATES

for ILGs. "I've found that in the Northeast, colleges and universities at best tolerate fraternities, whereas at MIT, the ILGs have been embraced to the extent of the administration's ability." The IRDF, he says, "has allowed the ILGs to provide safe, quality housing, while across the country houses are getting older and older and funds are not available to renovate." He says it is not unusual to hear of fraternity and sorority houses at some institutions being in such poor repair that they are condemned by local officials.

"This year we took out our fifth loan from the IRDF," reports Tim Collins, '89, a member of the Alumni Board of Delta Tau Delta. Like many houses in the system, Delta Tau Delta realized that it made a lot of sense to carry out other major renovations at the same time that the house updated its electrical wiring, sprinkler systems, and fire alarms to meet the requirements of MIT's Life Safety Improvement Project—all with IRDF support.

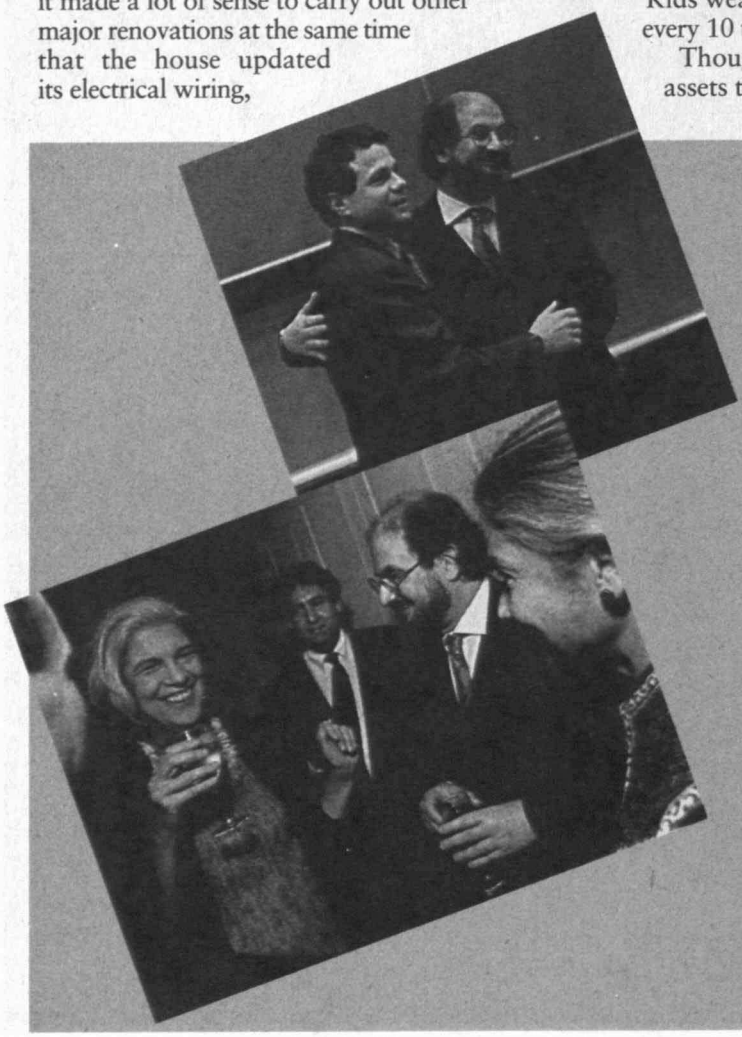
Lindsay Russell sees the IRDF as a well: funds are dipped out until the bucket scrapes the bottom, then the well is replenished by gifts and payments on principal and interest. Five years ago, when the well was topped off, the Allocation Board was in a position to loan the members of Alpha Phi $1.46 million to help them obtain the first sorority house in Boston's history. But money has been going out faster than it has been coming in for the last few years, particularly with the new, more stringent safety codes. "This is a never-ending business," says Russell. "Kids wear out the houses every 10 to 15 years."

Though the IRDF's assets total $11 million, the amount available for new loans fluctuates. The loan account was as low as $100,000 in June 1992, and no one who's had any experience with renovations needs to be told how fast a sum that size could be spent. So last fall the Institute launched a three-year, $2 million campaign to restore the fund. Russell says that an infusion of resources at that level will save money in the long run, as the ultimate costs are often higher if needed renovations are postponed for lack of money.

It's a giving opportunity that appeals to many veterans of the ILG system. "I can give to MIT, which makes me feel good," says Tim Collins, "and I can do something to help the independent residence community."

Information on the IRDF campaign is available from Diana Strange at the Alumni/ae Association (617)253-8215. □

—*AMY SOUZA*



***SALMAN RUSHDIE** has lived in hiding since a death sentence was issued against him by the late Ayatollah Khomeini of Iran in 1989 for his novel,* **The Satanic Verses.** *Rushdie was named an Honorary Visiting Lecturer of the Humanities at a surprise appearance at MIT in November. The occasion was ostensibly an MIT Writing Program presentation by author Susan Sontag. But after members of the audience were offered an opportunity to leave, the doors were locked, and Sontag introduced Rushdie. To end the terrorism of death threats against authors, publishers, translators, or booksellers, Rushdie called on the audience to put pressure on their governments. For citizens of a democracy, such death threats are an "insult to their freedom," he said. He was welcomed to MIT by physicist Alan Lightman (top left), head of the MIT Writing Program and a best-selling author himself. Following his address Rushdie talked with Susan Sontag (bottom left) and Phillip Khoury, dean of humanities and social science.*



PHOTOS: MIT NEWS OFFICE/DONNA COVENEY

**HANK BRANDLI, SM '65**

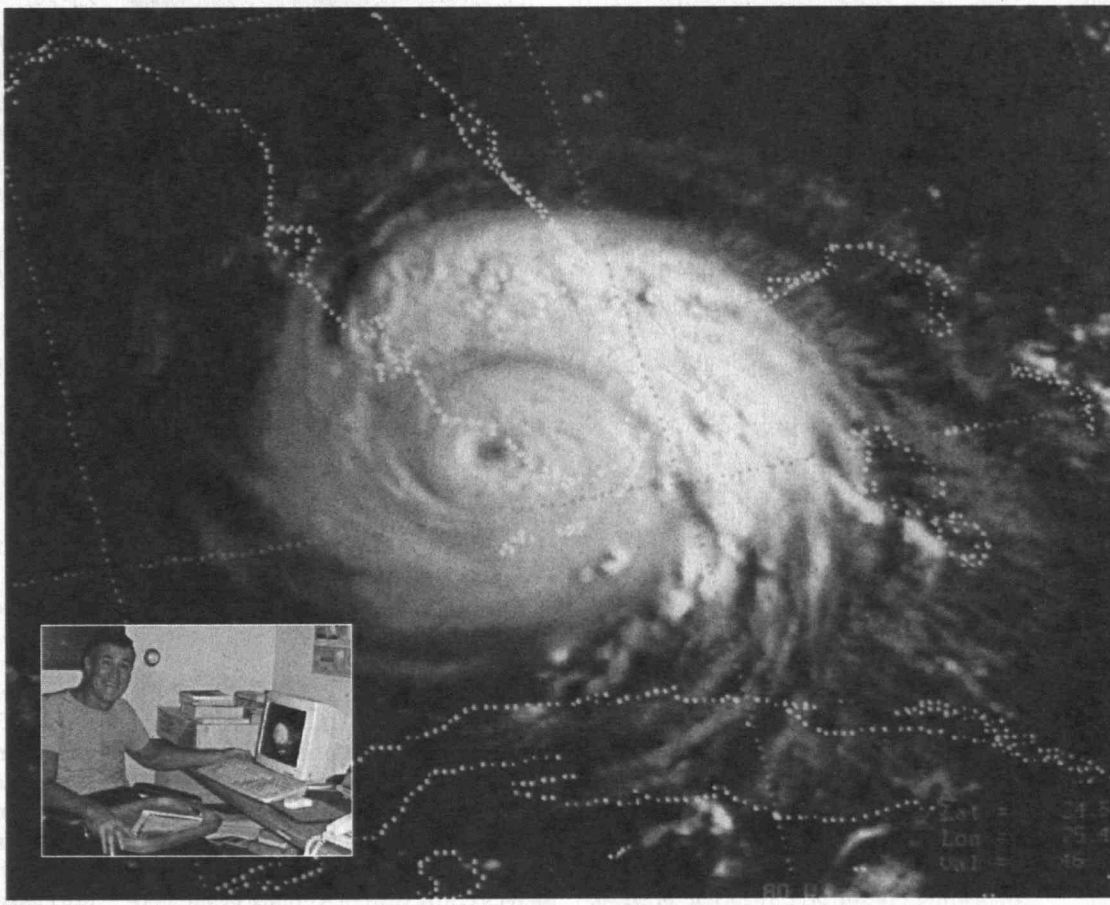
# *The Big Eye Doesn't Lie*

Get Hank Brandli on the phone and the only thing he wants to talk about is the weather. After 30 years as an Air Force meteorologist, it remains his passion. From aeronautical and meteorological studies at MIT, to tours of duty in Washington, D.C., Saigon, and Cape Kennedy (as it was then known), Brandli has spent his career pouring over weather satellite images, trying to gauge impending conditions.

Now retired from the Air Force, Brandli tracks satellites from his Florida garage. Multiple sclerosis has confined him to a wheelchair, but it cannot restrain this promoter, lobbyist, and shameless evangelist who extols the educational value of satellite-image interpretation every chance he gets.

"Reading weather satellite photos is becoming a lost art," he says in a typical rapid-fire burst. Too many people rely on published weather maps for meteorological information, he insists. With their superimposed illustrations of frontal systems, radar data, and jet streams, Brandli argues that weather maps are simply interpretations of satellite images—interpretations that actually delay the delivery of information and that are subject to error. Why not, he says, train newspaper readers and television watchers to go directly to the source? "The weather map could be wrong, but the satellite image is God's picture."

It is in studying those images that Brandli and others see opportunities for students to learn about meteorology, not to mention physics, chemistry, and other areas of scientific inquiry. Using satellite data, elementary school students can immediately test theories and predictions about natural phenomena because, as Brandli is quick to point out, "the big eye in the sky doesn't lie."



*Operating from a weather-satellite-monitoring station in the garage of his home, meteorologist Hank Brandli got the first known daylight image of Hurricane Andrew after it made its historic landfall in central Florida.*

### Inexpensive Technology Makes Weather Data Accessible to Anyone

Low-resolution (3 to 4 km) weather data have been available since the 1960s, free of charge, from the Automatic Picture Transmission satellites operated by the National Oceanic and Atmospheric Administration. But it is only the recent pairing of affordable microprocessor technology and imaging software that is putting this data on the desktop of the average person. Using a PC clone computer, homemade antenna, digital-to-analog converter card, and satellite-tracking software, Brandli monitors satellites from the United States, China, and the former Soviet Union. A comparable system would cost $500 to $1,800, plus computer.

Falling economic barriers strengthen the case Brandli and others make for the educational value of classroom-based, satellite-monitoring technology. Among

PHOTOS: HANK BRANDLI

those convinced were officials at the Technical Research and Development Agency (TRDA), a funding source created by the Florida state legislature to foster space research and education. Two years ago, TRDA offered a $200,000 competitive grant for installing school-based, weather-satellite monitoring systems and training educators in their use. Florida State University won the contract and has installed 74 systems to date, according to Paul Ruscher, assistant professor of meteorology at FSU. An Internet connection links the systems, permitting teachers to exchange ideas and data. With a goal of 100 systems installed statewide, Ruscher and his colleagues envision a technological infrastructure that can be used to excite students about careers in math and science.

As part of the TRDA grant, Hank Brandli led a workshop for educators. "He was a phenomenal resource," recounts Ruscher. Two years after the event, "people are still talking about his presentation."

**Show Stoppers**

In the classroom, Brandli delights in making weather relevant to his audience. He can show otherwise uninterested high-school boys how to predict surfing or fishing conditions. A movie buff, he also draws on modern films for examples. "I'll show kids an infrared picture of the Gulf Stream and try to relate it to a movie like *The Hunt for Red October*— to explain why, if you're a submarine captain, it's important to know about these things."

But his show stopper may very well be a full-color picture of Hurricane Andrew, taken three hours after it slammed into central Florida. Brandli's photo is the first known daylight image of the hurricane after it made landfall, and the editors of *National Geographic* magazine included it on their May 1993 "Geoguide" page for parents and children.

After seeing the Andrew image, Roger Hirschland, division editor in the Geographic Society's Geography Education Division, found himself taken with another piece of Brandli's work, a photo of North America on a cloudless, moonless night. A composite of three images transmitted by a polar-orbiting satellite in early 1991, "it is a startlingly clear photo of the entire continent," marvels Hirschland. The image "North America at Night" appeared in the Division's spring issue of *Update*, a quarterly educational newsletter sent to more than 100,000 teachers. (Brandli's 1979 capture of "North America at Night" appeared in the October 1985, issue of *Technology Review*, pp. 62–63.)

IMAGES CAPTURED BY THIS MISSIONARY OF SATELLITE METEOROLOGY HAVE BEEN FEATURED IN ANNUAL REPORTS AND *NATIONAL GEOGRAPHIC,* AND HIS ARTICLES IN PUBLICATIONS FROM *POPULAR MECHANICS* TO *MOTHER EARTH NEWS.*

Unfortunately, Hank Brandli is one of the few civilians who can create the North America at Night photo. The images come from a satellite in the Pentagon's Defense Meteorological Satellite Program (DMSP), whose transmissions do not include classified data but are encrypted nevertheless. The Air Force granted Brandli access to the satellites upon his retirement. For years, he has been lobbying the Pentagon to turn the encryption off, which he claims is as simple "as throwing a switch."

He notes that "with a DMSP satellite, you could study the aurora borealis, monitor the ozone, even detect wind speed below the clouds over the open ocean."

The Pentagon plans to start archiving DMSP satellite data and providing delayed access to scientists. But in light of the security implications in making real-time weather information widely available, there is unlikely to be any additional change in federal practice in the foreseeable future. Brandli is equally unlikely to stop arguing against the policy.

When he is not working with students or lobbying the government, Hank Brandli is writing articles for magazines as diverse as *Popular Mechanics* and *Mother Earth News*. But it was his series in the *Journal of the Environmental Satellite Amateur Users Group (JESAUG)* that brought him to the attention of New England science teacher Stephen Rocketto.

Rocketto runs an engineering club at the Ella T. Grasso Regional Vocational Technical School in Groton, Conn, and he was looking for material to help teach students how to interpret weather-satellite images. "Most of the material out there were college tomes at the graduate school level," says Rocketto, a former commercial pilot. When he ran across Brandli's *JESAUG* columns, "they were the best stuff I'd ever seen."

Rocketto has strong MIT connections: he participated in the MIT Science and Engineering Program for High School Teachers run by Professor Ronald Latanision and is active in the New England Science Teachers Association, which is an offshoot of Latanision's program. Rocketto used Brandli's material regularly, calling him to ask questions and seek advice. To date, the Connecticut teacher has helped install weather-monitoring stations in seven New England high schools, enabling them to track polar-orbiting and geo-stationary satellites.

Of Hank Brandli, whose written material helped to build the program, Rocketto remarks, "he has really made an outstanding contribution to education."

Meanwhile, Brandli carries on his crusade with characteristic good cheer. He is at work on his second book on satellite meteorology and chairs the Satellite Committee of the National Weather Association.

"Have a great day, baby," he calls out, hanging up the phone at the end of an interview. "Enjoy the weather." □

*—Carl Guess*

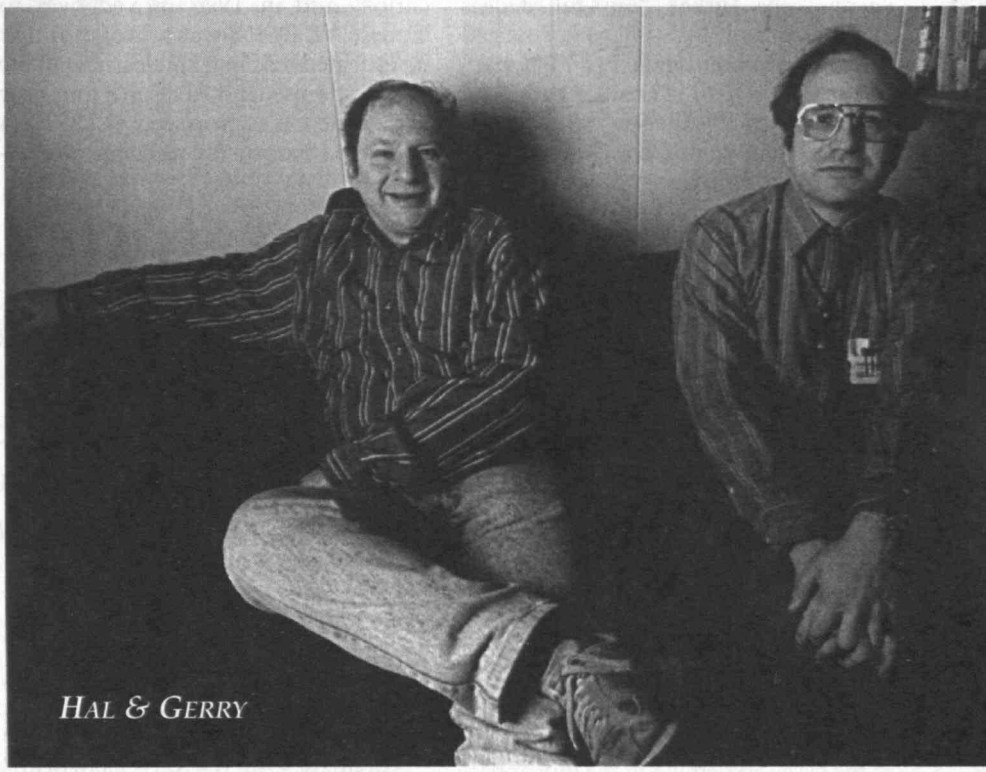
## HAL ABELSON & GERRY SUSSMAN

# *The Dynamic Duo of EECS*

"Students are a fog," observes Gerald J. Sussman, '68, PhD '73, when pressed to explain the workings of the teaching and research partnership he has formed with fellow EECS professor Harold Abelson, PhD '73. "They just hang around. We don't tell them what to do. One may happen to build an apparatus with me and then go to Hal for something else. It's an informal mess." Untidy their organization chart may be, but in a world where people keep saying that quality research shortchanges good teaching, Abelson and Sussman and their students are exceptionally good at both.

The Abelson and Sussman collaborative came to the attention of *Technology Review* when two of their 1992 PhD students, Elizabeth Bradley, '83, SM '86, (now on the faculty at University of Colorado, Boulder) and Mitchel Resnick, SM '88, (on the MIT faculty) won 1993 NSF Young Investigator Awards. This seemed noteworthy, since the prestigious awards go to less than 15 percent of the 1,500 nominees in a typical year. The awards provide a $25,000 grant in addition to matching industry support up to $37,500, every year for five years, and are designed to free young faculty to move in new research directions.To win, candidates must "have potential for being academic leaders in both research and education—to be superior in research is not sufficient," says Sue Kemnitzer, deputy director of NSF's Division of Engineering Education and Centers.

In fact, a total of four Abelson/Sussman protégés have won the NYI awards in the last two years. The list includes Kenneth Yip, '79, SM '81, and PhD '89; and Michael Eisenberg, SM '85 and PhD '91. (Yip is on the faculty at Yale, and Eisenberg also teaches at Boulder.) What's more, the teaching skill of the graduate students working with Abelson and Sussman has been recognized, and four of their students have been awarded departmental prizes for their undergraduate theses since 1986. Extrapolating that level of performance to the 28 doctoral degrees, plus scores of master's degrees and undergraduate theses completed under their supervision suggests a record that stands out even at MIT.



*HAL & GERRY*

The secret of their success, if there is one, begins in 6.001, "Structure and Interpretation of Computer Programs," a rite of passage for more than 600 freshmen and sophomores every year. It is in this class that many of their later advisees first encounter Abelson and Sussman. Professor Paul Penfield, Jr., '60, EECS department head, has described 6.001 as "the cornerstone of our undergraduate program"—it is required for every student majoring in Course VI.

Abelson and Sussman took over the teaching of the 6.001 precursor, 6.031, in 1981. In the ensuing years they have fine-tuned the course so that students emerge viewing themselves as designers of special-purpose programming languages. Learning a particular programming language and making a computer perform specific tasks are incidental. The Abelson/Sussman approach prompted another of their graduate students to describe them as "the greatest remote brain surgeons—they change the way you look at things."

In action in early October, Sussman held the floor in the 10-250 lecture hall, moving from the chalkboard to an overhead projector to notes on the desk. He peppered his presentation on "pattern-matching structure" with phrases such as, "Boy, is this hairy," and "Don't worry, you don't have to understand now." While outlining "the hairiest control structure we've seen [in this class] so far," he noted that, "one of the great skills of a programmer is knowing what not to understand. You don't have a chance if you try to understand it all." Meanwhile, Abelson sat near the back of the hall, monitoring the proceedings. By alternating teaching and observing, they are able to critique each other.

Veterans of this course return enthusiastically as teaching assistants and developers of new software. Franklyn "Lyn" Turbak, '86 and SM '86, now a doctoral

PHOTO: BENSON WEN '92

candidate in computer science, discovered Abelson's and Sussman's complementary differences in 1984, when he did his first stint as a teaching assistant in 6.001. "Gerry is a bundle of nervous energy," says Turbak. "He's full of ideas and excitement. If I want to get excited about my research again, I go to Gerry." Sussman is what Liz Bradley calls "the big picture guy." Abelson, on the other hand, is known for his command of details. "Hal will stand up and say, 'What you care about is this,'" Turbak reports, "and he'll say it in one beautiful sentence."

The 6.001 text, which the duo wrote with Julie Mazel Sussman, '70, Gerry's wife, has become the standard for computer programming instruction. The class is also available on video, and is used at other colleges and universities as well as in industry. It put the frosting on the cake when Abelson and Sussman received the 1992 Amar Bose Teaching Award—their department's highest teaching honor—for their efforts in the class. Something in the mix apparently rubbed off on Turbak as well: in 1986 he won two EECS departmental teaching honors and in 1990 won the Goodwin Medal, the top Institute-wide, graduate-student teaching prize.

Abelson's introduction to computers in education began quite accidentally. As a new graduate student in mathematics at MIT in 1969, he checked in to see what was going on at the President's Office, which had been taken over by the Students for a Democratic Society. One of the demonstrators turned out to be from Hal's high school, and when he wasn't involved in political action, he worked at the Artificial Intelligence Laboratory. He suggested Abelson check out the lab, advice that the latter accepted without having any idea what it might entail. As a member of the LOGO group headed by lab co-founder Seymour Papert, Abelson subsequently helped develop the original screen "turtle," a successful teaching tool and one of the first computer displays that could be used remotely over a telephone line.

Completing a PhD in algebraic topology in 1973, Abelson joined the MIT faculty, first with a joint appointment in the Department of Mathematics and the Division for Study and Research in Education, and in 1977 moved over to Course VI. DSRE was a program that investigated teaching and learning in the broadest sense, and Abelson's four-year involvement was prophetic: in 1992, his continued passion for teaching was recognized when he was named to the inaugural group of MacVicar Faculty Fellows at MIT.

> IT WAS AS GRADUATE STUDENTS IN MATHEMATICS WORKING IN THE AI LAB WHEN ABELSON AND SUSSMAN DISCOVERED A SHARED SENSE THAT IT IS A DEEP INTELLECTUAL PROCESS TO EXPLAIN AND TEACH SOMETHING.

Sussman, now the MIT Matsushita Professor of Electrical Engineering, also received a doctorate in mathematics from MIT in 1973. He had had the chutzpah and competence to carve himself a niche at the AI Lab as a (pre-UROP) freshman in 1964, and has worked at the lab ever since. His honors have included selection as a International Joint Conference on Artificial Intelligence Lecturer in 1981 and the Association for Computing Machinery's Karl Karlstrom Outstanding Education Award for 1991.

Both Abelson and Sussman credit the seemingly unstructured mix of teaching and research in the AI Lab with setting the tone for their own academic enterprise. It was in that setting, says Abelson, that he and Gerry discovered a "shared sense that it is a deep intellectual process to explain and teach something." They describe the learning environment of the AI Lab as "wonderfully informal," but Papert is more blunt. "My idea of teaching is to let students see my way of learning and allow them to learn in the same messy way," he says. He finds it "rewarding, even awe-inspiring, to think about a learning style passing down through generations," and to think that he may have been an influence on Hal and Gerry's students.

Another element of their intellectual heritage was the influence of Professor Emeritus Robert Fano, '41, ScD '47. As young faculty members, both Abelson and Sussman taught 6.031 with Fano, on separate occasions. "Fano was one of the first people to think of computation as the glue that holds community together—incredibly forward thinking," says Abelson. He is still guided by Fano's philosophy that teaching involves "striving for perfection."

Along with all that theory, Abelson has great people skills. "He knows whose work is ready to present, and where there is a conference that offers the best audience for that paper, and he drops a hint for you to follow up on," reports Liz Bradley. "He can get you to make a small course correction that can change your whole career path."

Abelson and Sussman direct the MIT Project on Mathematics and Computation, a joint effort of the AI Lab and the Laboratory for Computer Science, which builds tools for scientists and engineers. The group has developed programs that monitor experiments and interpret the results in qualitative terms; they constructed special-purpose computers that predict the long-term motions of the planets; and they incorporated computation in physical structures—building "active beams" that can support a much heavier load than normal. The group draws on its leaders' tremendous range of interests. Sussman, for example, is a registered locksmith, a skilled machinist, and a member of the American Watchmaker's Association and the American Astronomical Society. "Gerry knows so much about so many subjects," says Turbak, "he makes people want to go out and learn more"—and then teach, we'll warrant. □ —*Stephanie Grepo*

# ClassNotes

## 15

Please send news for this column to:
Miss Joyce Brado, secretary
491 Davison Road, #9
Lockport, NY 14094

## 16

Please send news for this column to:
Bob O'Brien, secretary
25 Keith Road
Pocasset, MA 02559

## 17

Please send news for this column to:
Don Severance, secretary
29 Hampshire Road
Wellesley, MA 02181

## 18

Please send news for this column to: Class Notes Editor
*Technology Review*
201 Vassar St.
Cambridge, MA 02139

## 19 75th Reunion

My enthusiasm for an MIT class of 1919 reunion in the year 1994 has subsided somewhat but if I am still alive then I now plan to do so. The deaths since the last class reunion have made it unlikely that there would be those living who would be able to attend.

The recent deaths of **Don Way** and **George Michelson** have eliminated two who might have made it. Don and I each worked many years closely associated with the Singer Manufacturing Company. George Michelson was always ready to pitch in and help. **Don Flynn** is still with us but likely not in shape for a reunion. I hear from **Francis Weiskittel** and he is interested in our class but not likely to attend a reunion at this time. **Leo Kelley** is also interested but is in a nursing home in Texas. **Robert MacMullin** would be a welcome guest but is unable to at his age. We wish he could be with us on such an occasion. I mention those men who might come if they could. So unless any others who may read these notes has any suggestions, I guess this is it for now.

Kindest regards to you all.—**Bill Langille**, secretary, Box 144, Gladstone, N.J. 07934, (908) 234-0690

## 20

Please send news for this column to:
**Harold Bugbee**, secretary,
313 Country Club Heights,
Woburn, MA 01801

## 21

It is with heavy heart that we record the death of a dear friend, Mrs. Alexandra Eden Hawes, wife of the late **Munroe C. Hawes**, chemical engineering. Alex and Munnie were neighbors of ours in nearby Sea Girt and helped Maxine and your scribe find a suitable house for retirement in the New Jersey shore area. We greatly miss both of them. Active in local affairs and at our class reunions, the couple is survived by a fine family of two sons, three daughters, Alex's sister, fourteen grandchildren, and six great-grandchildren.

A gift to the MIT Libraries in the form of an endowed fund named for her late husband, **Elliot T. Adams**, chemistry, has been established by Mrs. Onie Adams. The fund will serve for the acquisition of books within the scope of the history of science, with emphasis on mathematics and related fields.

We often have wondered how many libraries are at the Institute, including the Central Library under the Great Dome, the Hayden Library, the departmental libraries, and those of each member of the faculty, administration, special research projects, archives, publications, and student organizations. Anyone care to guess?

Adding to the detailed attendance roster for our 70th Reunion (*Technology Review*, January 1994), both **Benjamin Fisher**, mechanical engineering, and **Roy D. Snyder**, electrochemical engineering, have new home addresses. You can reach Ben at 180 Main St., #243, Walpole, MA 02081, and Roy at 806 E. Third St., Bloomsburg, PA 17315-2017.

'Tis the season to be merry and nothing could be finer than to have you cheer us up in return for the times each year we do it for you. Start now with a note to your secretary covering your activities.—**Carole A. (Cac) Clarke**, secretary, 608 Union Lane, Brielle, NJ 08730, (908) 528-8881; **Samuel E. Lunden**, assistant secretary, 6205 Via Colinita, Rancho Palos Verdes, CA 90274, (213) 833-1480

## 22

MIT Provost Mark Wrighton sends us a letter: "I am delighted to inform you that we have changed one of the Class of 1922 Career Development Professorships to a full chair by adding the income balance of Class of 1922 Growth Fund. The accumulated earnings of the Growth Fund together with the principal in the career development chair will total just over $2 million, an amount sufficient to permit honoring a senior faculty member as a Class of 1922 Professor. I am enthusiastic, as I know you are, by the opportunity for such an appointment. Opportunities to recognize senior faculty who are outstanding teachers and contributors to the educational program are of vital importance. MIT—and particularly the faculty who benefit directly from the class's generosity—are enormously appreciative of the support of the Class of 1922."—**Martha Munzer**, secretary, 4411 Tradewinds Ave., E., Lauderdale-by-the-Sea, FL 33308

## 23

My request for news from classmates was answered by **Sherwood L. Berger**. After graduation he traveled for two years through the Midwest on business. He then settled in New Britain, Conn., where he founded a fuel oil business. He lives on a 50-acre farm and spends the cold winters in a retirement center.

In my senior year at Tech, I had two roommates in the Phi Mu Delta house. One was **Fernando de la Macorra** who came to one of our reunions—the 55th, I think. Instead of going to the Cape with us he went into Massachusetts General Hospital a very sick man. From there he flew home to Mexico City and passed away soon after. . . . My other roommate was **Roger Cutting**, who died July 25, 1993. Mary and I visited Roger a number of times at his home on Cape Cod. He leaves a son (also a Tech grad), two grandchildren, and two great-grandchildren.

Mary and I have had a hot summer in Florida, but it is beginning to cool down. It would be nice to hear from other classmates. Bring us up to date.—**Royal Sterling**, secretary, 2350 Indian Creek Blvd. W., Apt. D-201, Vero Beach, FL 32966, (407) 562-3937

## 24 70th Reunion

I regret to write that an alumnus of great stature has passed on. **Jimmy Doolittle** (Air Force General James Harold Doolittle), 96, died September 27, 1993, in his home in Pebble Beach, Calif. The Monterey Peninsula was quite proud of our hero. The local newspaper had four articles about him on four consecutive days. (See next page.) In his honor there was a flyover of Pebble Beach by B24 bombers.

In the April 1993 issue of the class column I reported on his latest honor from the National Academy of Engineering. They named him a distinguished honoree for his service to the advancement of aviation, engineering, and the nation. A great person has passed by and we are much the richer. The family was in Washington, D.C., for the funeral at Arlington National Cemetary where he was given full military honors. His wife, Josephine, died in 1988. Doolittle is survived by his son, John, of Pebble Beach, 6 grandchildren, and 14 great-grandchildren. The family prefers that contributions

in his memory be sent to the donor's favorite charity.—Co-secretaries: **Katty Hereford**, 237 Hacienda Carmel, Carmel, CA 93923; Col. **I. Henry Stern**, 2840 S. Ocean, #514, Palm Beach, FL 33480

## 25

It is time to remind all classmates that the 70th Reunion is only about a year away and some planning is already in order. President **Courtenay Worthington** has given the matter some thought and feels we should go along with the program offered by the Cardinal and Gray Society. If you have ideas, Court would appreciate hearing from you. He can be reached at 54 Phillips Ave., Rockport, MA 01986. Telephone: (508) 546-7893.—**F. Leroy (Doc) Foster**, secretary, 434 Old Comers Rd., P.O. Box 331, North Chatham, MA 02650

## 26

Please send news for this column to: **Donald S. Cunningham**, secretary, Eventide, 215 Adams St., Quincy, MA 02169, (617) 328-1840

## 27

As there is no particular news to report from the Class this month, I take the liberty of telling of my experiences this past summer. President **Harold (Bud) Fisher** and I represented our class at MIT Technology Day last June. I also attended my 70th Reunion at Phillips Exeter from which 12 of our MIT classmates graduated. Of those who can claim this distinction, just two others remain: **Carleton Davies** of Charleston, S.C. and **Lee McCanne** of Old Lyme, Conn. It was a pleasure to represent my class of 1923 as president and return to the place of my youthful endeavors and memories.

My family celebrated with two weddings of grand nieces in Maine atmosphere, and time brought three great-grandchildren into my family.

Phyllis and I enjoyed the summer at our cottage on the Sheepscott River on the Isle of Springs, just west of Boothbay. A chilly summer overall, the water temperature never reaching over 60 degrees. But many days were sparkling clear with ideal sailing breezes. I still have my 33 ft. Morgan sloop *Flying Gull* and as long as I can climb on board, I intend to keep sailing. There's no more beautiful sight than viewing the Camden Hills from Penobscot Bay sailing among its many islands. **Roger Nowland** and his wife have a lovely home overlooking a portion of Blue Hill Bay with a lighthouse tower study room.

Early October brought the most colorful trees in Maine and New England, primarily from the chilly nights and sunny days. But heating a summer cottage finally demands a return to our balmy Florida residence. As I write now, after a swim in the 87 degree pool, we can relax and enjoy the Florida breezes with our southern friends. We recommend this life for all my classmates.—**Joseph C. Burley**, secretary, 1 Harbourside Dr., Delray Beach, FL 33483; **Lawrence B. Grew**, assistant secretary, 21 Yowago Ave., Branford, CT 06405

## 28

The dearth of class news for this issue of the *Review* continues, though I have received belated information of the death of **Robert Cook** on November 4, 1992. Bob was in civil engineering and after graduation was engaged in surveying the Lake Maracaibo oil fields in Venezuela before engaging in general

***The life of General James H. "Jimmy" Doolittle, '24, ScD '25, was filled with speed records, medals, and firsts in the field of aviation. While he received the Medal of Honor for his daring raid on Tokyo just four months after Pearl Harbor, he felt his greatest contribution to aviation was his work developing blind-flying instrumentation and high octane fuels that made the high-performance aircraft of World War II possible. Those who knew him admired his personal qualities of patriotism, humor, courage, intelligence, honor, and humility. He was a life member, emeritus, of the MIT Corporation. General Doolittle died at age 96 on September 27, 1993, at his home in Pebble Beach, Calif.***

# ClassNotes

construction contracting in the U.S.

As I write these notes I have received a request from the Owls Head Transportation Museum at Owls Head, Maine, to write a short story for its *Strut & Axle* quarterly that centers on automobiles and the people behind their wheels at the time I was at MIT (1924–1928). You may remember the racy speedsters in which **Arthur Nichols** and his brother William ('27) commuted to Tech. Art had the one with conventional rear drive and Bill had the one with a then unconventional front-wheel drive. Also, remember the Ford Model T that ended up on the roof of '93 Dorm during a whoopee break and that took a Tech maintenance crew an entire day to get back on the ground?

Had a nice short talk on the phone with **Florence (Jope) Smith.** She is making a slow recovery but enjoys hearing, by phone or note, from old friends. Florence is at Cogswell SE Rm. 271, Carleton-Willard Village, 100 Old Billerica Rd., Bedford, MA 01730, (617) 275-2802.—**Ernest H. Knight**, secretary, Box 98, Raymond, ME 04071

## 29 65th Reunion

I received a letter from Donald Baumrucker, the eldest son of **Bill Baumrucker,** informing me that his father had a stroke last May 13 that has left him with a partial loss of using and understanding words. "Everything appears to be all right with the rest of his body for which we are thankful. My father and mother, Doris, celebrated their 65th anniversary in April. The two of them still live alone in their large house that my father bought in 1954 on Marblehead Neck. They have two grandaughters, one a junior in high school and the other a junior at Tufts. My parents send their very best to each and every member of the MIT class of 1929."

Shortly after the sad announcement of Bill's illness, Doris sent a note adding: "Bill was so pleased to hear from you and from the MIT Alumni/ae Association. He still has to allow the slow process of recovery. A stroke is a personal thing, no one knows how long the recovery will take."

A note from **Donald S. Hersey** of East Hartford, Conn., and wife, Eleanor, reads: "Thank you for the birthday card for my 88th! With the help of our doctor and several pills a day, I and my dear wife of 61 years manage to stay in our home with reasonable comfort. I have stopped night driving but continue driving short distances for shopping. Can still play keyboard and paint pictures in my second floor studio. I have completed several paintings this summer and fall."

A note from **Eric A. Bianchi** of Tequesta, Fla., and wife Helen as follows: "In December 1992 we enjoyed a 15-day cruise from Ft. Lauderdale via Panama Canal to spend Christmas with my son and family in Pasadena, Calif. We spent three months this summer at Eastman properties in Grantham, N.H., to escape heat and humidity in Florida. This was our eighth summer at the same location, and we look forward to number nine in 1994. My Helen's health is good, she still can play golf in spite of spinal stenosis, which does limit her playing activity. Fortunately, my health is excellent, plagued only by minor arthritis, for which I am mighty thankful. At the moment, our attendence at the 65th Reunion is doubtful since we will not arrive in New England until June 21."

Sara, wife of **Amasa "Mace" Smith,** Birmingham, Ala., writes, "Mace was 87 and I was 84 in August. God has blessed us so very much. October 14 is our 60th wedding anniversary—a wonderful marriage. Mace has impaired eyesight due to a coma. We listen to the radio. We are active in our Presbyterian Church. There are churches that have a touch of liberalism we don't like. Mace does not drive anymore, is not interested in sports enough to listen to it on the radio. Our bachelor son lives close to us, and we have two daughters in Atlanta, one in Florida."

I regret to announce the death of two of our classmates: **Anthony Standan** of South Kent, Conn., June 22, 1993, and **Harold Nash** of Simsbury, Conn., September 30, 1993. Harold, an engineer who had been employed at Veeder Root in Hartford, was a member of the Eno Bridge Club and Simsbury Codgens. He is survived by his wife, Ann, 3 daughters, 18 grandchildren, and 9 great-grandchildren. He was predeceased by his wife, Dorothy, his son, Col. Harold Nash, Jr., and a grandson, Stephen Coley.—**Karnig S. Dinjian,** secretary, P.O. Box 83, Arlington, MA 02174, Telephone in Florida: (407) 395-2890

## 30

As forecast in last month's Notes, in mid-September Louise and I moved from our condo in Southbury, Conn., to Apt.#40 at Williamsburg Landing, a life-care facility in Williamsburg,Va.

We plan to keep our Green Valley, Ariz., home for winter living. Shortly after our arrival in Williamsburg we were touched by the long arm of coincidence. On our second day at the Landing, while Louise patronized the hairdresser, I wandered into the library and was astonished to find a copy of the October issue of *Technology Review* on the periodical rack. From its mailing label I learned that it had been sent to Doris Donely who is the widow of Philip Donely, '31, and *mirabile dictu* lives in Apt. #41. Doris kindly arranged a cocktail party at which we met a number of our new neighbors.

**Bill Cullinan** sadly reports from Cape Elizabeth, Me., that his wife, Janet, died in 1990 on their 57th wedding anniversary. He still goes to their Ocean Village home in Ft. Pierce, Fla., where his daughter also lives. It appears that the outstanding golf game he previously played has become a "memory." He reminisces about several past achievements. In 1984 he played in a PGA Seniors Pro-Am with Peter Thomson and their team won first place; in 1986 he shot a 77 and 78 a week apart at age 79. At his winter home in Ocean Village he has had five holes-in-one. In respect to non-golfing achievements, in 1987 the FAA Eastern Region established an Honorary Airport Award and named it the William E. Cullinan Award. Bill speculates that the FAA may have thought he was already dead.

As many of you will recall, our classmate **Joseph Harrington, Jr.,** who died in 1986, was the second of a series of four Joseph Harringtons to receive an MIT degree. We now have at hand a sad note from Joseph Harrington III telling us that his mother, Alene, died last July. Those who regularly attended our quinquennial reunions will recall that Alene customarily accompanied Joe Jr. to the reunions and contributed to their success. In addition to Joe III, '61, and Joe IV, '88, she is survived by two daughters and four grandchildren. . . . Maggie and **John Scheuren** made another trip to Europe in June 1992 during the course of which they visited the Scheuren Winery in Mesenich/Mosel that is now operated by Aloys Scheuren and produces Riesling wines.


***John Scheuren, '30, visited the winery in Mesenich/Mosel operated by his German kin.***

John and Aloys share a common 17th-century ancestor. John says that as a result of the turmoil of the 30 Years War, a number of Scheurens, including one of John's ancestors, Nicholas Scheuren, came to this country where they fought in all of America's wars, sometimes on both sides. On the return flight to Boston on American Airlines the pilot gave him a navigation chart showing an air field on the east coast of Greenland that John had built in 1957–60. It was originally the eastern terminus of the "DewLine" and is still used by Icelandic and Odin Airlines.—**Gordon K. Lister,** secretary, 5707 Williamsburg Landing Dr. #40, Williamsburg,VA 23185

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Please send news for this column to:
**Wyman P. Boynton,** secretary,
668 Middle St.,
Portsmouth, NH 03801

## 32

After 52 years of distinguished federal service, Col. **William L. Glowa** retired on April 30, 1993. Lt. General Thadeus Wolf, the commanding general of the air combat command gave the main speech at the retirement ceremony. He stated that Col. Glowa was the "father of the U.S. Air Attache System in the World." Looking over Bill's resume, we can see he was always busy planning air route manuals, operation plans, and organizing high

*Bill Glowa*

level conferences of generals. He also was active in seeing that scientific and technical developments in 67 U.S. defense and aerospace industries were properly distributed. His last assignment was as executive secretary of National Elint Group, whose purpose was to determine the issues and problems facing the intelligence community and the military services. Bill, I suspect your years of retirement will be active ones!

**Russ Robinson** is full of plans to see that our April mini-reunion in Tucson will be a success. The geographical distribution of our classmates who are planning to attend is as follows: New England, 6; Hawaii, 2; California and Washington, 3; and Arizona, 2.

I must say that I am disappointed that we did not attract more from the middle and far West. I guess octogenarians must be careful how they plan six months ahead.

**Harner Selvidge** writes that his physical condition is not improving as much as expected. He would welcome a visit from any classmate who comes to Sedona. He is busy writing his memoirs. Volume I came off the presses in September. Volume II is underway. He is simultaneously preparing three other books. Harner, please send us a letter about your writings.

Our most indefatigable travellers must be the **Tom Westons**, although the **Marshalls** give them a race. Tom writes about all his trips of the past year, family reunions, cruises, and social gatherings. Perhaps the most colorful was the trip in Disney World with his family. They decided that "Gramps Tom" should be equipped with a wheelchair so that all events could be covered at top speed. They did the ride down "splash mountain"—a five-story plunge at a 45 degree angle.

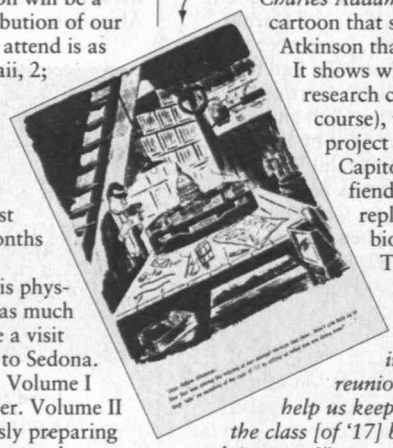
**John Brown** and I attended the MIT Leadership Conference held at MIT on October 2. We got an inkling of what it takes to run the Institute, and how important the volunteer alumni/ae are. Two tidbits of information stand out in our memory. (1) Biology is now a core science for all freshman—same as physics and chemistry. (2) The importance of a "hands-on" approach to education.

All for now.—**Melvin Castleman**, secretary, 163 Beach Bluff Ave., Swampscott, MA 01907

## 33

The *60th Reunion Class Book* records the personal and professional experiences of some 75 survivors after their MIT mindset. A 76th entry refered the inquisitive to: 1) *American Men & Women of Science*, and 2) *The World of Charles Addams*, p. 15. Here then is the unauthorized biography of Dr. **Edward R. Atkinson**—born February 15, 1912, in Boston (no doubt a product of its schools, as well); married to Lorraine Crittendon in 1944, now with two daughters in their 40s; MIT degrees—SB, 1933, and PhD, 1936, both in chemistry, Course V. He was a teaching fellow pursuing a doctorate before teaching at Trinity College, Conn., from 1936 to 1939. From there he went to the University of New Hampshire as professor of chemistry from 1938 to 1951. Industrially he was with Dewey & Almy from 1951 to 1957, and then with Arthur D. Little from 1957 to 1977, retiring as an industrial consultant. During his industrial affiliations, Dr. Atkinson was a lecturer at Northeastern University (1951–1963) and at Boston University (1964–1965). My *25th Reunion Class Book* credits Dr. Atkinson with 35 papers and patents in organic chemistry. He has been the recipient of the Henry A. Hill Memorial Award and the 1981 American Chemical Society Award.

Chasing down a copy of *The World of Charles Addams*, I found a full-page cartoon that says more about Dr. Atkinson than a thousand words. It shows what I presume to be a research chemist (retired, of course), whose sole remaining project is to dynamite the U.S. Capitol building. Most fiendishly clever of "Ed" replying to a request for biographical material. The cartoon's caption reads: "*Dear Fellow Alumnus: Your face was among the missing at our annual reunion last June. Won't you help us keep 'tabs' on members of the class [of '17] by telling us what you are doing now?*"



By way of **Bill Klee**, I have a letter from **Walter Vernon Skees** announcing his abdication as president of Skees, Ltd., of New Providence, Bahama Island, to his son Walter Fitzerl after over 30 years in that spot. His address now is Apartado 627, Barcelona 08080, Spain. Walt writes that of the dozen MIT graduates in Spain, he is the only American. He would have attended our 60th Reunion but demurred because of arthritis. Living in the most beautiful city in the world cannot be too difficult. Barcelona and Walt were meant for each other.

Our Class President **Wilbur (Bill) Huston** and wife Dorothy have taken off to Arizona after their foreign travels in September 1993 to corroborate the arrival of their 10th grandchild. Perhaps at the 65th Reunion we should award a grand prize to the classmate with the most grandchildren. Keep in touch!

A classmate whose biography in the *60th Reunion Class Book* seems brief is **John C. King, Jr.**, who received an SB in Course I, civil engineering. In 1935 he received an SB from the University of Colorado and then married Mart Kelly in 1936. They had two daughters and a son. After Mart passed away in 1983, John married Freddie King three years ago, saying she got the worse of the "for better or worse." John was one helluva concrete engineer, having worked on Boulder Dam and on the Mackinaw Bridge (between upper and lower Michigan), for which he co-authored *Mackinaw Straits Bridge Substructure Design and Construction* with O.H. Millikan. During World War II he was made a major and executive officer, 321st Engr. Bn. (Combat) with the 96th Infantry Div., which participated in the initial landing of the Philippines campaign. John says, "I attend conventions in the U.S. and Canada as well as conferences in Japan. . . . enjoy tobacco, a martini or two, *and have developed a sense of humor about my blindness*." Enough said: John may be reached at 17928 Nottingham Rd., Cleveland, OH 44119, or at (216) 486-1062. He likes surprises, especially birthday parties.—**Berj Tashjian**, secretary, 1245 Briarwood Lane, Northbrook, IL 60062, (708) 272-8683

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Please send news for this column to: **George G. Bull**, secretary, 8100 Connecticut Ave., Chevy Chase, MD 20815

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**John S. (Jack) Holley**, living in Chula Vista, a San Diego suburb, telephoned last week to compare notes on how we were faring in the maturing process. He is recovering from last winter's surgery and, like most of us, is limited in his activities (his wife does the driving). We plan to get together in December when my church choir joins with the Chula Vista Presbyterian Church choir in a Christmas program. I *can* say that Jack still has an active sense of humor.

**Arthur H. Cohen** brings us up to date on his and wife Joyce's activities. Last July, they moved into a two-bedroom corner apartment on the fourth floor at 55 Hill Road in Hill Estates, Belmont, Mass. Lots of room for living and storage, plus a balcony and panoramic view from many windows. They attended Pops and Technology Day last June and saw **Phoenix Dangel** from our class. They spent part of the summer on Nantucket with daughter Samantha and two grandchildren. Son Robert came up from Montclair, N.J., to help with the move. They were planning to spend Thanksgiving in Portland, Ore., with daughter Eileen and grandchildren. All three of their children are married and living with spouses. Boca Raton, Fla., is usually their winter home. Arthur does some consulting on architectural work but is mostly involved with managing a 7-building, 11-tenant Industrial Park he owns in Woburn, Mass. He is busy with Temple Shalom of Newton, Mass., and points out this year is 5754. Arthur and Joyce will be celebrating their 54th wedding anniversary on February 6.

Your secretary traveled back to New Hampshire for a family reunion on last September 25 at the Beede House in Sandwich, Mass. Thirty descendants of my mother and father attended from as far away as Juneau, Alaska. We had a great time on the only warm, sunny day of the weekend. The Beede House was built by Elijah Beede in 1797 and has been in the family ever since. It was used by MIT varsity oarsmen twice as a staging area for climbs up Mt. Washington in the fall and winter of 1934.

My telephone is always available if you do not have the time to write.—**Allan Q. Mowatt**, secretary, 715 N. Broadway #257, Escondido, CA 92025, (619) 432-6446

# ClassNotes

## 36

Wrapping up the results of traveling to a June wedding in Virginia, I will report the news and views by telephone from several classmates who were unable to attend the luncheons along my way. **Dan Carroll** (Course VI) in Media, Pa., told of 40 years with the Bell system and of a spiritual awakening in the '60s which led him to prepare a lecture and discussion course on the Scriptures. Using a video camera, he projects some 400 passages on a TV screen to groups at various churches. They meet for six 1 1/2 hour sessions, with almost no dropouts. His son Joseph was a missionary to Brazil for seven years, and later, pastor of a church in Folsom, Pa. . . . From Haverford, Pa., **Hamilton Migel**'s wife, Barbara, recalled their 30 months in London in the '60s, when Ham (Course II) set up a manufacturing plant and office for Magnaflux Corp., replacing agents, to meet the growing demands of success abroad. Magnaflux, started by Professor A.V. de Forest, was Ham's career as he helped to build the organization. He told me of a son Hal living on the outskirts of Santa Fe whom they have visited many times. Barbara describes this area as "my favorite place to live."

**John Roberts** (Course X-A) entered our Chem Engineering Practice School from Dartmouth, but because his major there was physics, he had to take "a year of MIT chemistry indoctrination" first. He recalled being with **Ed Nicholson**, Tony Dauphine, Reid Ewing, and others on snow trains, and the weekend blizzard in 1934(?), which paralyzed the Boston area. Only the railroads could operate, and North Station was a dead-end when John and friends returned. So they skied up Beacon Hill to the State House, down the grand front stairway, over the Longfellow Bridge, and home to the dorms. John is retired from several fields of engineering at DuPont. He explored computer applications to chemical and mechanical problems from the earliest days, and lectured on the subject for the AICE.

**James Carr** founded his own company, incorporated, retired as president emeritus after many successful years, and sold the firm in 1985. It represented a number of clients, including Weyerhauser Corp., in Maryland, Virginia, and D.C. The company designed, fabricated, and erected structural timbers, including those huge laminated beams visible in churches, gyms, auditoria, and some residential structures. He was president of the National Capital Section of the American Society of Civil Engineers. As an undergrad Jim played varsity lacrosse three years, and he recalled his teammate, captain, and roommate **Joel Bulkley** (deceased 1970). He also spoke of **Tony Hittl**, an acquaintance since Course I days. . . . **Aldo Bagnulo** (Col. U.S. retired, Course I) was in Boston at the time of the D.C. luncheon in June, and when I telephoned in September he had severe laryngitis. Now in October, wife Helen told of a remaining problem with his vocal chords, and a CAT-scan is scheduled. Aldo had a long, worldwide, and honored career with the Army Engineers (see 50th biography), beginning in World War II when he commanded a regiment in Europe and Okinawa, and later on loan to NASA for construction of launch facilities at Kennedy Space Center.

In the October issue, my report on **Howard Turner** was inaccurate, and particularly the National Academy honor. He was elected to the National Academy of Engineering in 1972. Howard took the MIT trip to the North Pole on a Russian icebreaker last summer. He reports an exciting trip on a nuclear-powered vessel, with a bow designed to slice through the several feet of ice, or failing that, to ride up on the ice cap and break it down by sheer weight.

In May **Edward Christopher**'s wife, Rebecca, replied to my visitation proposal, saying that he had Alzheimer's disease and required 24-hour care. A second letter with a news clip told of his death September 6. Both letters portray a gentleman nicknamed "professor" by family and friends—one who instilled an esprit de corps in his work and many activities. A highlight in his 50th biography was "marriage to my high-school chum." Ed was a cryptological mathematician for the War and Defense Departments, and lastly the National Security Agency where "he was a grandfather of agency activities." Cheers for the life of Rebecca's extraordinary man! . . . And for **Thomas Chang**, whose mail from the Alumni/ae Office was returned marked "deceased," and no family information is available from his biography. However, it shows that after his SM in architecture at the Institute, he continued studies at the Ecole des Beaux Arts in Paris and was in the Army Air Force in World War II. Later he was an associate of firms in California and Pennsylvania, where he attended alumni functions. He was assistant art director for Walt Disney, 20th Century Fox, Warner Brothers, and Universal Studios. In Hong Kong he designed the first high rise building—a bank and office center. . . . And a letter also from **Bill Saylor**'s wife, Carol, that he died October 2. He had Parkinson's disease from 1983 on, and recently suffered strokes. In 1932 Bill and I were competitors for the New Jersey MIT Club freshman scholarship, and he won. After graduation in Course VI-A (SB and SM) he taught briefly there, and went into engineering and sales with General Radio. He retired in 1965 to give full time to hybridizing and plant breeding, and in 1979 won the silver medal of Massachusetts Horticultural Society for his work in gesneriads. A toast to his life!—**Frank L. Phillips**, secretary, 1105 Calle Catalina, Santa Fe, NM 87501, (505) 988-2745; **James F. Patterson**, assistant secretary, 170 Broadway, Pleasantville, NY 10570, (914) 769-4171

## 37

If you thought you noticed a slight difference in writing style in the class notes, you were right! **Len Seder**, your assistant class secretary, has taken over reporting the notes every once in a while and has done an admirable job, for which I am most grateful. He also is disappointed when we have very little news for you. So please keep us busy—let us hear of your interests and activities.

Received information from the Alumni/ae Association that **Walter S. Wojtczak** received the Bronze Beaver Award. Awards were announced during the Alumni/ae Leadership Conference in October 1993. The Bronze Beaver is given in recognition of distinguished service to the association and/or Institute, and is the highest honor the association can bestow upon any of its members. Congratulations, Wally! . . . **Joe Keithley**, founder of Keithley Instruments, Inc., is still working. He also spends time writing his story of electrical and magnetic instruments. He and Nancy travel to many places in the U.S. and once in a while to Europe. Says he enjoys traveling.

Received a pleasant call from Ann and **Michael Zinchuk**. Ann tells us that Mike has taken over household and nursing duties very capably. Ann had hip surgery and during her recovery period fell and broke her leg. She's coming along fine and was looking forward to having the cast removed the following day. (So much for the golden years.) . . . Learned that **Stan Zemansky**'s wife Anne, an MIT graduate ('39), passed away in September 1993. Our deepest sympathy to Stan and his family.—**Robert H. Thorson**, secretary, 66 Swan Rd., Winchester, MA 01890; **Leonard Seder**, assistant secretary, 1010 Waltham St., Lexington, MA 02173

## 38

At this time your secretary, **Horace Homer**, is recovering from an illness. We wish him a full recovery. During this interim, please send news for this column to: **Frederick J. Kolb, Jr.**, president, 211 Oakridge Dr., Rochester, NY 14617

## 39

## 55th Reunion

**Paul Gordon**, professor emeritus of metallurgical and materials engineering at the Illinois Institute of Technology, received the 1993 Albert Easton White Distinguished Teacher Award from ASM International last October 19 at the group's annual meeting in Pittsburgh. The citation recognizes unusually long and devoted service in the teaching of materials science and materials engineering, coupled with an ability to inspire and impart enthusiasm to students. Paul received bachelor's, master's, and PhD degrees in metallurgy from MIT.

In a recent speech, MIT President Vest mentioned: "MIT routinely leads all other universities in patents granted. For 1992, its total was 126 as compared with 81 for the next highest recipient."

**Fred Grant**, chair of our 55th Reunion Committee, reports all activities are on schedule. He says, "The green banana syndrome notwithstanding, individual classmates can help most by mailing their commitments early so that room reservations and other arrangements can be confirmed."

**Al Thackara** and Cynny travel the world, making 16mm movies and videos. They present travelogues to various charitable groups. With 90 passengers they recently cruised to Bora Bora on a French ship named *Windsong*, the sails and booms of which are computer-controlled. Between travels Al plays tennis three times a week in Laguna, Calif. . . . **Nick**

**Shoumatoff** and Nina have also traveled the world over, and he lectured at foreign and domestic universities. Now in retirement in New Bedford, Mass., Nick is seeking a publisher for his new book on the history of and his observations (over 35 years) about the Alps mountains. Nick is research associate of the Carnegie Museum and is preparing articles for this year's 100th anniversary celebration of Carnegie-associated organizations.

**Lawrie Fabens** created a program to optimize design of bearings. There are 30 input variables. Lawrie and Alicia are stimulated by imagining the great potential in sometimes small phenomena. They see a tiny bi-metal gadget plugged into the battery circuit of their automobilethat can heat or cool, depending on the polarity. Coupling this concept with his understanding of future transmission of electricity at zero resistance, Lawrie visualizes the potential of converting coal to electricity at mine sites and transmitting power at zero resistance to whole cities far away. Lawrie seeks news about **Barry Graham** and **Hans Bebie** and Austie, and said he and Alicia would be at our 55th.

**John Alexander** and Nancy wrote from Shanghai: "We climbed the Great Wall of China near Beijing. We saw many gardens over the countryside. Large crowds everywhere, especially at rush hours. School kids sing their songs on tonic scale and it is melodious. We return October 25." John's card was postmarked in Shanghai and arrived here two days after he and Nancy arrived home in Bellevue, Wash. That tells me rickshaw mail delivery hasn't changed pace since I was last in Taipei and Hong Kong.

**Donald Gleason** and Vi offer topical comment as these notes are being written just before Halloween. Don has been reviewing and arranging manuscripts at the Peabody Essex Institute Museum Library of History and Art in Salem, Mass. He found fascinating stories about witchcraft and witching. With **Frank Recca**, they will be at our 55th and should have some unusual stories to tell during attitude-adjustment sessions.

**Ida Rovno Gordon** enjoys tennis and grandchildren, and recently traveled to Portugal, Spain, and France. She is skilled in analyzing investments. . . . **Will Jamison** and his son engineer foam fire-fighting equipment for applications where water is not available. . . . **Sam Sensiper** and Elaine walk and swim in Los Angeles, and travel to professional meetings about antennas.

**Morgan Sze** is retired in Portsmouth, N.H., after a full career in the international chemical engineering world. These days he reads molecular biology and listens to CD recordings. When he and I graduated from MIT we had no idea we would meet again 20 years later in Chung Ju, Korea, to train Korean Nationals to operate their new ammonia-urea plant, producing 250 metric tons per day of urea prills in polyethylene bags.

**Shorty Merriman** and Nina enjoy good health and close family ties, and look forward to reminiscing with old friends at our 55th. . . . **Don Timbie** and Barbara retired to Pennington, N.J., after a career in patent law. Don reads history. His current interest is to read the Bible from cover to cover and then travel to the Holy Land to see it as is. When he gets to the Middle East he may have occasion to see classmate Professor **Joseph G. Zeitlen** at the Israel Institute of Technology in Haifa.

We are saddened by reports of deaths of three classmates. **Anne Alice Zemansky** graduated in architecture and worked in that field until World War II when she joined Douglas Aircraft to do heating and ventilation design. Anne and her husband designed and built several of their homes, including the one in paradise, Calif. She died September 25, 1993. . . . **John B. Rippere, Jr.**, died October 26, 1992, in Long Beach, Calif. There were no details. . . . **Joseph F.R. Weston** died July 4, 1993, in Monument Beach, Mass. There were no details.—**Hal Seykota**, secretary, 2853 Claremont Dr., Tacoma, WA 98407

## 40

A recent call from **Amos Joel** informed me that he had been awarded the National Medal of Technology by President Clinton at a White House ceremony on September 30, 1993. Also present at the South Lawn presentation were Vice President Al Gore and the Under Secretary of Commerce, who read the citations. Amos sent me several newspaper clippings, which provided additional information. Amos "was recognized for his key role in creating the most technically advanced public telephone system in the world. He was cited for the advances—particularly in switching systems—in which he played leading roles. Those advances have had a major impact on the evolution of the telecommunications industry and are used every time someone picks up a phone. As a result of his many significant contributions to public network switching technology and his prolific writing about it, people in the telecommunications industry have long referred to Joel simply as 'Mr. Switching.'" Another article states, "Today he is one of the persons most responsible for giving the world call waiting, call forwarding, and cellular car phones." Amos retired from AT&T Bell Labs in 1983, and is currently an executive consultant to the firm and other companies.

A recent letter from **Walter Helmreich**, our class agent, states that he will keep me informed on class giving. He included the report of our donations to the Alumni/ae Fund for FY93 (ending 6/30/93) as follows: "We have 365 active alumni/ae, and of these, 184 gave this year for a 50 percent participation. This is about the same as neighboring classes, but last year we had a 55 percent participation. Of the 184 donors, 66 percent gave at least $100, which is the same percentage as last year, but not up to the level of our neighboring classes. It would be great if we could raise the percentage of donors giving over $100 to nearly 100 percent. The class of 1943 has reached 83 percent. Our total alumni/ae giving this year is $293,430, which is good. Thanks to the class of 1940 for helping MIT keep on course."

There are several obits to report this month. **John E. Tyler** of La Jolla, Calif., passed away on June 27, 1992. In Ponce, Puerto Rico, **Lawrence E. Welch** died on July 13, 1991. There is no further information on either of these classmates. On March 26, 1993, **Alfred J. Rice** died in Greensboro, N.C. After service in the army during World War II, he became a realtor and was a president of the Greensboro Board of Realtors, president of Piedmont Sales and Marketing Executives, a former radio announcer, and a member of the Young Men's Sunday School class at his church.

On August 14, 1993, **John T. Muller** passed away in East Falmouth, Mass. He retired 18 years ago from his position as a resident engineer at the Woods Hole Oceanographic Institution. After being a member of the U.S. Power Squadron for 26 years, he was recently made a life member.

Another death was reported to me in a letter from **David "Beano" Goodman**. He writes, "**George Carnick**'s son, George, Jr., called me yesterday to tell me that George had died a day or two earlier (about August 26, 1993). He died of pneumonia brought on by heart problems, which had bothered him for the past few years. George and I roomed together in Bemis our junior year, and I've more or less stayed in touch through the years. George graduated in Course V, then went into the Coast Artillery, then anti-aircraft. I ran into him in London during World War II when he came down to see me wrestle in the British national tournament in 1944. After the war, he went back to Columbia and became a CPA. He practiced in New York and Newark until he retired. George was both an outstanding goal tender on the hockey team and a very tough and successful 135 lb. wrestler. He was also a thoughtful and good friend. I'll miss him."

By now, you will have heard of the change of date of the 1995 alumni/ae activities coinciding with our 55th Reunion. Class president **Norm Klivans**' letter states that we will go to Woodstock, Vt., on Tuesday and Wednesday, June 13 and 14, and then be in Cambridge June 15 and 16, 1995, for Tech Night at Pops and Technology Day. If you did not complete and return the questionnaire included with Norm's letter, find it, and send it back now. And be sure to include information for these Class Notes.

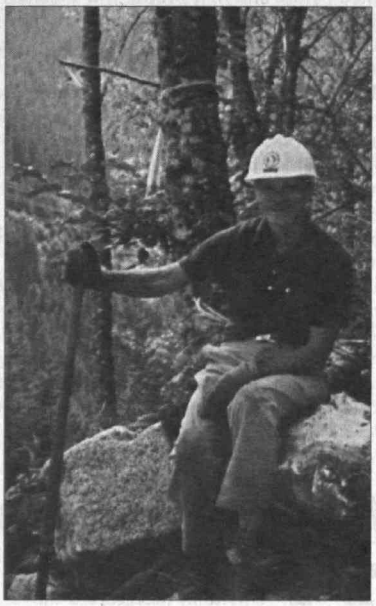
Or else send items directly to me.—**Richard E. Gladstone**, secretary, 250 Hammond Pond Parkway 1205 S, Chestnut Hill, MA 02167, (617) 969-5161

## 41

I missed the late September deadline for the January issue after receiving an envelope from MIT, enclosing my October and November/December disks, but no class information or deadline.

**Bill Kussmaul**'s, wife, Dorothy, writes that Bill's "gallant struggle with multiple sclerosis, which had begun to affect him by the 40th Reunion, was ended by congestive heart failure on August 31, 1993.... Our daughter, Ann, is a professor of economic history at Oxford University and our son, Bill (III), is a cardiologist, director of the Cath Lab at Pennsylvania Hospital. Tech people may be interested to know that our oldest grandchild, Mary, a junior at Stanford, is a member of their sailing team. I plan to continue at this address: 9701 S.E. County Hwy 25-144, Belleview, FL 34220."

Bill was a close associate of mine in Course X and ROTC for four years. In his contribution to the 25th Reunion Yearbook he describes working for a short time after graduation for the Socony Vacuum Oil Co. before entering service, getting married, having a daughter, traveling over the United States at 35 mph, and spending six months in Hawaii. Mustered out as a captain, he worked for



*Sam Fry, '41, helps to transform the Iron Goat Trail, an abandoned Cascade Mountain railroad grade, into a hiking trail.*

Allied Chemical Corp. and Magnus Chemical Corp. before being called to active duty at the outbreak of the Korean conflict, as commander of the 29th Ordnance Battalion, Peekskill, N.Y., National Guard. After commanding two successive ordnance battalions in the States, he went to Korea as senior advisor to the Republic of Korea Ordnance School, and then to Japan in a similar assignment for the emerging Japanese army. He was awarded the Bronze Star by the United States and the Chung Mul (Distinguished Military Medal) by the Korean Government. Returning home, he played an active part in the U.S. rocket program and received the Legion of Merit. Bill was buried at Arlington National Cemetery with full military honors. We express our sympathy to Dorothy, his wife of 51 years, their two children, and four grandchildren.

Early October brought a flurry of notes: **Sepp Dietzgen** received the Harold E. Lobdell '17 Distinguished Service Award on October 2, during the Alumni Leadership Conference at MIT. The award recognizes "valuable alumni relations service...of special depth over a sustained period." They didn't have to tell us in the Class of '41!

Paul R. Krugman, a member of the Department of Economics, has been appointed to the Class of 1941 Professorship for a five-year renewable term. Professor Krugman, who earned a BA from Yale University and a PhD from MIT in 1977, taught at Yale before joining the MIT faculty in 1979. He is a renowned authority on international trade, author of numerous books, the recipient of several honors for his works, and has served on the Council of Economic Advisers. The class looks forward to enjoying our association with him, as we did with his predecessor, the late Professor Friedlander.

**Mac Gardiner** encloses a full page *Mercer Islander Reporter* article about **Sam Fry**. (No information about Mac!) The headline, at least one inch high, "Still Blazing New Trails," caps a picture of Sam in hard hat, holding a shovel, backed by spectacular mountain scenery. It seems that Sam, with his abiding interest in the outdoors and history, has taken over the rebuilding, as a hiking trail, of an abandoned section of the Great Northern Railway near Stevens Pass in the Cascade Mountains. This abandoned railroad grade, The Iron Goat Trail, will soon become the latest addition to the spectacular Cascades hiking trails. Those of you who know Sam and have reviewed his contributions to the 25th and 50th Year books, will know that he is an experienced mountaineer and has climbed Rainier, St. Helens, Kilimanjaro, and the Matterhorn. Those in Washington State should know that you are subject to draft for his trail work!

**Robert Wallace Blake** has been traveling again! He went on "a tour of Siberia and the Russian far east, September 10–22. This was an Alaska Airlines tour out of Anchorage, with travel within Russia beyond the gateways on the Trans-Siberian Railroad and Aeroflot." After flying into Kabarovosk in eastern Siberia (one day) and proceeding by rail to Irkutsk and Lake Baikal (four days), Aeroflot returned Bob to Vladivastok for tours of the city. Bob should stay out of Russia. Boris Yeltsin dissolved parliament the day before he departed. During his last Russian trip, exactly two years ago, the coup against Gorbachev occurred!

**Ivor Collins** writes: "Traveling in Tennessee in September we stopped in Tullahoma to see **Rudy Hensel**. He retired from Arnold Engineering Development Center in 1980 and is in his second career as an investment advisor. Rudy is still active in track events. He is on the Board of the AEDC Foundation which aims to preserve the legacy of General "Hap" Arnold and other aerospace pioneers.

"Things continue to go well in the life-care retirement community where Shirley and I are now the editors of the internal/external monthly newsletter. I was sidelined for a while from a radical prostatectomy. A routine physical disclosed an enlargement, a biopsy showed malignancy, and the surgical option seemed preferable. Post-op PSA tests indicate that all the cancer has been removed, and I'm recovering well. More details available to anyone who's involved with prostate problems."

I had lunches with **Chet Hasert** and two of the ubiquitous Course XVIers who visited him recently. **Quentin Wald** was on his way from Singer Island, Fla., where he sold his latest boat. He was headed to his former home in Connecticut and thence to Bellingham, Wash., where he plans to take up residence near his son. Quentin has had many sailing adventures in the Caribbean, the Greek islands and even had the experience of a collision with another sailboat in mid-Atlantic, no other traffic in sight! Later, I saw **Connie Nelson**, who had visited **Bill Lamar** in Dayton, Ohio, was on his way home to Minneapolis. Connie has been active in a cultural exchange with the sister city of Minneapolis—Ibaraki, a suburb of Osaka, Japan. He spent a month there and lived in a Japanese home. Both Quentin and Connie promise fuller accounts of their adventures for a future column.

Washington, D.C., has a very active MIT Club, which is actively supported by members of our class. A reception at the Russian Embassy, scheduled for October 7, was postponed to October 11, when President Yeltsin declared the original date a national day of mourning in Russia because of the tragic events earlier in the month. Four of us in our 50th Reunion red coats rescheduled and attended a very interesting evening. We were greeted by Ambassador Vladamir Lukin and heard a talk by Dr. Lev Muhkin, senior councilor for science and technology: "The State of Science and Technology in the Russian Federation." Both he and Ambassador Lukin indicated that the Federation was interested in pursuing scientific cooperation with the United States and hoped we were not losing interest in space exploration, which they considered important to the future of the planet. A lively discussion with members of the audience ensued. After a reception, the evening culminated with a specially prepared, traditional Russian menu served buffet style. The accompanying photo records some participants the event, in all their 50th Reunion finery—classmates **Ralph Hunt, Chet Hasert, Robert Wilson Blake,** and your secretary.—**Charles H. King, Jr.**, secretary, 7509 Sebago Rd., Bethesda, MD 20817, (301) 229-4459

# ClassNotes

*THE ART OF SCIENTIFIC DIPLOMACY—Four members of the Class of '41 joined in the post-lecture discussion on "The State of Science and Technology in the Russian Federation" at the Russian Embassy in Washington, D.C. From left: Charles King, Jr., Ralph Hunt, Chet Hasert, and Robert Wilson Blake.*

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# 42

Here's a "first" for our class—a street naming. The main thoroughfare of the East Mountain Business Park in Wilkes-Barre, Pa., Business Park was named **David Baltimore** Drive in honor of David's 47 years of contribution to the community. . . . Details are being worked out for the **Jack Sheetz** Memorial Fund. **Lou Stouse** will donate $10 for each $100 given to the fund. More in our next column.

**Alan Katzenstein** reports that **Harvey Kram** has been appointed to the MIT Council of the Arts. The class is already represented on the Council by Alan and by **Bob Greenes**.

Just heard from Betty Speas that **Charlie Speas** died last October. A class leader and a hard worker for MIT, he was known as "Mr. MIT of Baltimore." He served two terms as president of the Baltimore MIT Club and headed the Educational Council there for many years. Charlie received the Bronze Beaver in 1977. As requested, he was buried in his red Class of 1942 50-year jacket.

I can always use more news. It doesn't have to be world shaking, just what you've been doing and whom you've seen or even heard about.—**Ken Rosett**, secretary, 2222 Americus Blvd., N., Clearwater, FL 34623

# 43

**George W. (Bill) Potts** sent a gratifying volume of communication for this month. First is the news that four class members live in or near Leesburg, Fla. (pop. 15,000), the highest concentration of '43 alumni/ae anywhere. Besides Bill and Chic, there are Ann and **Bill Seitz**, Fran and **Bob Lynn**, and **Bob Millar**. In proof, I have a photo of the Bill/Bobs and spouses gathered together. Incidentally, Bill Seitz, who is assistant rector at St. James Church in Leesburg, has been hospitalized with prostate cancer, but with a favorable prognosis. . . . Bill Potts also sent a copy of MIT Department of Military Science Special Orders No. 6, dated April 30, 1940. This document lists the names of 51 good men and true who were awarded the Order of Military Merit for outstanding achievement in M.S. **Jim Malloch, Malcolm Walker**, and **Fred Mulhaupt** were among them, as well as **Bill Thurston**. Brother Potts obligingly sent copies to all the survivors of illustrious Company "A." Anyone else wishing a copy may request it from me, sending the usual SSAE.

Last September, the *Boston Globe* printed two lengthy articles about **George Freedman** and his cohorts. With more than 100 patents to their credit and another hundred in development, these four inventors formed Invent Resources to solve problems for a fee. (Hired technology-slingers—"Have invention, will travel.") After receiving degrees in metallurgy and physics, George spent 40 years with Raytheon, much of the time in the new products center developing improvements to microwave cooking technology. His tenure was briefly interrupted with the ultimately unsuccessful launching of Tyco Semiconductor Corp., which George calls a valuable learning experience. Now retired from Raytheon, he works from his home in Wayland, Mass. The *Globe* article prominently featured a quote from George's book, *The Pursuit of Innovation*. "The creation of something that never existed before and that people will someday buy, use, and even delight in, is one of the most remarkable processes human beings can engage in."

Treasurer **Hans Walz** estimates that the conservative 50th Reunion budget will result in a healthy surplus. . . . **Stan Proctor**, evidently still riding high from his successful Class Gift campaign, has accepted appointed as class agent.

Some of you may remember a permanently stooped-over alumnus of '13, on crutches, who crashed our 35th Reunion dance with the complaint that all of his classmates had gone to bed while he was still looking for some action. I am accepting nominations for the member of our class most likely to repeat that performance in 2008.—**Bob Rorschach**, secretary, 2544 S. Norfolk, Tulsa, OK 74114

# 44 50th Reunion

As these notes were being written, we received the update on our 50th Reunion from **Norm Sebell**. To review the highlights: Friday, May 27, we lead the processional at commencement; Monday, May 30, we depart Cambridge for Samoset Resort in Maine; Thursday, June 2, we return to Cambridge for Tech Night at the Pops; Friday, June 3, Technology Day activities in the morning and early afternoon, then later a reception given by President and Mrs. Vest, followed by a dinner dance at Walker Memorial. There is still time to make arrangements to attend, so don't put it off for another moment. We look forward to a great turnout.

The class was well represented at the October '93 Alumni/ae Leadership Conference. Present for all or part of the meeting were **Frank Carroll**, Diane and **Andrew Corry**, Jane and **Louis Demarkles, John Gardner**, Mary and **Al Picardi**, Elizabeth and **Caspar Schneider, Norm Sebell, Joe Shrier**, and **Melissa Teixeira**. As always, the program was outstanding. If you get a chance to attend a future conference, please give it serious consideration. We're sure you will find it rewarding.

At this writing, a small group of your classmates is trying to put together the 50th Reunion class booklet. We thank all who have contributed and hope you will be pleased with the result.

Please send us news for the column.—Co-secretaries: **Andrew F. Corry**, P.O. Box 310, W. Hyannisport, MA 02672; **Louis R. Demarkles**, 77 Circuit Ave., Hyannis, MA 02601

# 45

After careful and detailed research by Jan and **Charlie Patterson** plus Anne and **Bob Maglathlen**, your 50th Reunion Committee has decided that our off-campus headquarters will be the Black Point Inn at Prouts Neck, Maine. Prouts Neck is on Saco Bay between Old Orchard Beach and Cape Elizabeth some 20 miles south of Portland, Maine, and about 1 hour 38.5 minutes NNE of Boston; see your friendly road map or NOAA Chart #13286 or #13287. We know you will enjoy; please set aside now June 12-15, 1995, for our 50th Reunion off-campus activities.

# ClassNotes

With considerable remorse, we report the death by cancer of **Sherry Ing** on October 8, 1994. Arthur Schwartz, '47 (an original classmate), called me on Monday, October 11, at 6:00 a.m. PDT to advise me and forwarded Honolulu newsclips later that week. Although Sherry was a quiet, demure individual in our eyes, he was dynamite when it came to his Hawaiian leadership role. The following is Sherry's own synopsis dated June 1970:

"In July 1969, I started my own real estate company with plans to develop apartments, hotels, and office buildings throughout the State of Hawaii. I will start construction on a large 450-unit, 40-story condominium apartment building in Waikiki as our first project. For the previous 12 years, I was executive VP for a Hawaiian corporation whose principal activity was the development and ownership of hotels, apartments, and office buildings. Hawaii has experienced a tremendous economic growth during the past 10 years, and the future outlook is even brighter.

"After graduating in 1945, I spent several years in the Navy and then returned to MIT for a second bachelor's degree in mechanical engineering. This was followed by two years at the Harvard Business School. After graduating from Harvard, I returned to Honolulu and joined the Hawaiian Telephone Co. for eight years and headed their Business Research Department. I have been married to Julia Sia (Mount Holyoke, '50) for 19 years. Our oldest daughter will enter college this fall, hopefully in the New England area."

It is safe to say that the past 23 years have been more of the same—particularly Sherry's management and principal ownership of Aloha Airlines and his active leadership in keeping C. Brewer & Co. Ltd., Hawaii's oldest local corporation, in local hands. We extend the sympathy of the class to Julia, Louise, Laura, Carolyn, Richard, and the five grandchildren.—**Clinton H. Springer**, secretary, P.O. Box 288, New Castle, NH 03854

## 46

In the absence of any other inputs, we can simply send this little message to all our good old friends to urge everyone to let us all know how things went during the previous year. I hope we will have lots of news in the April's issue. TH-TH-THAT'S ALL FOLKS. TAKE CARE; KEEP IN TOUCH.—**Jim Ray**, secretary, 2520 S. Ivanhoe Pl., Denver, CO 80222

## 47

**Abbot Fletcher** wrote to tell us about his latest sailing adventure. Last June he skippered *MAJEK*, his 37½-foot sloop, to first place in the 645-mile Marion, Mass., to Bermuda race. His son, Maxwell, was the navigator—which is quite a responsibility in this race because high-tech navigating equipment is not permitted once the boats are offshore. Maxwell relied on dead reckoning, star sights, and sun sights. Abbot has owned *MAJEK* for 28 years. She has won 125 trophies in approximately 210 races and was one of the oldest boats in this race.

**John Yocum** responded to our plea for news and sent us a letter. He retired at the end of 1990 as VP and chief consulting engineer from TRC Environmental Consultants, a company he helped found in 1970. However, he discovered that after 43 years in the consulting business he couldn't go cold turkey, so he's still working part time. Also, he tells us he published his first and only ("never again") book (with co-author S.M. McCarthy), called *Measuring Indoor Air Quality—A Practical Guide*. John and wife Betty do a fair amount of traveling and have "discovered the joys of Elderhostels." In 1991 John gave a paper on air pollution measurement in Odessa, Ukraine. His timing was interesting—it was during the period between the attempted overthrow of the government in Moscow and the disintegration of the Soviet Union. John comments that is is sad to see how little is known about the practical aspects of pollution control in Russia. John also tells us he occasionally teams up with **Ed Kane** on consulting projects.

In October 1993, **Robert Hagopian** was given MIT's Bronze Beaver Award. This is given in recognition of distinguished service to the Alumni/ae Association and/or the Institute and is the highest honor the association can bestow upon any of its members.

We have a delayed obituary notice this month—**Keith Knutzen**'s daughter reports that he died in October 1991. Keith was born in Salisbury, Rhodesia, and came to the U.S. to study architecture at MIT. After graduation, he returned to Africa to teach architecture at the University of Witswatersrand in Johannesburg and later went into private practice with his wife. He was a member of a number of civic organizations in Africa and the American Institute of Architects here. After the death of his wife in 1976, he returned to the U.S. to work and to join his children. He then met and married Mildred Adams McLearn and they lived in Bronxville, N.Y., until his death. He is survived by his wife, a brother, a son and daughter, and one stepson and stepdaughter.

A final note—**Mike Hardy** stopped in while visiting family in Denver last August. Mike and I both resided at the Student House while at Tech, and we also wrote our thesis together. Mike retired in 1981 and has just been enjoying life ever since.—**R.E. (Bob) McBride**, secretary, 1511 E. Northcrest Dr., Highlands Ranch, CO 80126

## 48

**Milton Slade** received the Harold E. Lobdell Award for his loyal and unassuming dedication both as a fund-raiser and as a class officer; for distinguishing himself as an exemplary supporter of both the Institute and the Association of Alumni and Alumnae of MIT. The award was presented at the awards luncheon during the annual Alumni Leadership Conference on campus. Next year Milton will serve as president of the Instrumentation and Measurement Society of IEEE.

Ann and **Ken Brock** spent a wonderful day—and night—with Eileen and **Bill Zimerman**. Bill continues to operate Zimmerman Holdings and in addition is vice-chairman of the Board at Harvey Mudd College. Shortly after that trip, Ken and Ann went to Bermuda to revisit their honeymoon haunts of 35 years ago.

**Denny McNear**, our class president, met with **Graham Sterling, Sonny Monosson, George Clifford, Milton Slade, Bill Maley**, and yours truly to discuss class activities for the next five years. Our class has been successful in conducting various activities with a core group of supporters in the Boston area, and in maintaining communication with a larger core group living at various distances from Boston. Reunions held by our class in 1985, 1988, 1991, and 1993 were well attended by classmates from nearby and from distant cities such as Tulsa, Pasadena, Dallas, Washington, Ridgewood, N.J., St. Louis, and Akron. The class officers are exploring all the options to increase participation by members of the class in our activities. Bill Maley, our class agent, discussed plans he is making for fund-raising.

**Bob Sandman** and his wife, Tel, spent a few weeks in the country of South Africa. . . . **Tom Lacy** wrote to report the death of his friend and our classmate, **Bill McEwen**. Tom and Bill had been friends for over 50 years. Bill graduated from Exeter Academy in 1941 and entered MIT with the class of1945. Bill joined the Beta Upsilon Chapter of Beta Theta Pi and later became chapter president. Bill continued his service to the Beta Upsilon chapter for much of his adult life as secretary of their alumni group.

Bill served in the Army Air Corps during the war and graduated from Course XV with our class. He progressed through the investment division of Employers Liability Assurance Corp. Ltd. in Boston to become VP and manager of its Investment Division. He held the same position a successor firm, Community Union. Bill was a longtime resident of Lexington, Mass. After retiring in 1977 he became a resident of Naples, Fla., while retaining his summer residence in Chatham, Mass. On behalf of our classmates I extend our sympathy to Bill's wife, Priscilla, and her family.

**Carl Boll** died after an extended illness with cancer of the lung. Carl came to MIT from Andover during the war. Carl and Ken Brock were in the V-12 program and they roomed together. They were transferred to Tufts and again were roommates. Returning to MIT as a junior in the fall of 1946, Carl was active in squash and lacrosse and then became interested in student government. He was chair of the Budget Committe, a permanent subcommittee of the Institute Committee. The position gave him use of an office in Walker Memorial with a telephone that greatly enhanced Carl and Ken's after-dark careers.

Ken recalls how he and Carl purchased (at a nickel on the dollar) a barrel of hard cider, which they stored on the balcony of their suite. **Dave Cist** assisted with obtaining a hose to siphon the keg, and everyone else assisted with consuming the cider. **Jules Levin** and Bill Zimmerman lived on the floor below Carl, and they could keep track of everything going on upstairs.

Carl operated his family business, which recycled contaminated organic solvents. As the government changed the rules for handling organic solvents, business became increasingly stressful. Provisions introduced retroactively, making earlier acceptable procedures unacceptable, were a major problem for Carl's business.

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Carl and his wife, Shirley, lived in Rumson, N.J. He loved sailing all his life. He and Shirley kept their boat in Nova Scotia for three years and sailed across to Newfoundland many times. They raced to Bermuda and last winter their last cruise was on the Intercontinental Coastal Waterway. They stopped when Carl became to ill to continue. On behalf of our classmates I extend our sympathy to Carl's wife, Shirley, and her family.—**Marty Billett,** 16 Greenwood Ave., Barrington, RI 02806, (401) 245-8963

# 49 45th Reunion

Please send news for this column to: **Fletcher Eaton,** secretary, 42 Perry Drive, Needham, MA 02193, (617) 449-1614

# 50

Greetings Class of '50 from your new acting class secretary. **Bob Mann** asked me to fill in temporarily for **Jack McKenna.** Jack suffered a stroke following heart bypass surgery and feels he is not able to do right by the job for the time being.

On a happier note, please send me your ideas for our 45th Reunion in June 1995. Bob has appointed Susan and **Mal Green** as co-chairs, and they have begun planning.—**Robert A. Snedeker,** 7 Mashie Way, N. Reading, MA 01864-3423, (508) 664-1738

# 51

Selected as the John F. Elliot Lecturer and Medalist, **George St. Pierre** will deliver four-five lectures during the coming year. Having retired as the chair of Materials Science and Engineering at Ohio State University in 1992, he continues to serve as the presidential professor emeritus. He has also been a member of MIT's Visiting Committee on Materials Science and Engineering.—**Martin N. Greenfield,** secretary, 25 Darrell Dr., Randolph, MA 02368

# 52

I am obliged to **Stan Sydney** for sending me the unhappy news that **Walter Robert Beckett** died September 10, 1993. Bob studied civil engineering as an undergraduate, and later earned a master's degree in geotechnical engineering from MIT. He served in the U.S. Air Force during the Korean War, worked for several years in Venezuela building roads and dams, and was a partner in a construction firm in Watertown from 1971 to 1977. He also served as a consulting geotechnical engineer to MIT's Department of Civil Engineering. He owned a business that built several tennis clubs and developed housing in the Sudbury area. He is survived by his wife, Ann, two sons, and his mother.

The names of **Robert Ely** and **Charles Schwartz** were included on a list of physics faculty at Berkeley who had recently taken early retirement. I saw a TV news interview of Chuck protesting some delinquency of the administration of University of California whose nature I did not catch. He seemed to be quite angry about it. He may have retired, but he certainly has not become retiring.—**Richard F. Lacey,** secretary, 2340 Cowper Street, Palo Alto, CA 94301; e-mail: lacey@hpl.hp.com

# 53

More news on the 40th Reunion attendees. To be truthful, henceforth I must rely on my memory and a post-reunion printout provided by the Alumni/ae Association, the latter of which probably includes the names of some no-shows. Thus, if you presence or absence is misrepresented, let me know and a correction will be made.

**Lionel Kinney** and his wife reunited with us on campus and at the Cape. He is senior staff engineer with Caterpillar Inc. in Peoria, Ill., and resides there as well. . . . At Tech Night at the Pops, Dory and **Jim Howard** joined us for a pleasant greeting. He is president of Andruss-Peskin in Natick, Mass., but lives in Wayland, Mass. . . . **Bob Colton** and wife were with us for all four days; they now live close by in Bethesda, Md., and he serves as president of Robert M. Colton Associates. Among other matters, he arranges peer reviews for university research proposals. . . . **Harold Sherman** and his wife also were on campus and at the Cape. Currently he is president of Inductametals Corp. in Chicago and lives on North Lake Shore Drive.

**Jay Berlove,** now government and business manager for E-Z-EM Co. on Long Island, attended the MIT festivities; unfortunately, Carol was unable to join him. In case you wondered—yes, he still plays poker. . . . Also joining hands at MIT were **Jerry Connor** and his wife. He is a long-time MIT professor in civil engineering. . . . Grayce and **Sid Hess** took part in the full reunion and insured that our officer election ballot boxes were not too overstuffed. They now live in Chadds Ford, Pa., and he is a visiting professor of management and organizational sciences at Drexel. (Why is it they never seem to age, gracefully at that? Sorry, Grayce, I couldn't stop myself.)

Many of us were delighted to greet **George Hegeman** at the Saturday dinner at the Cambridge Hyatt, especially since we recall his contributions to previous reunions, for which we thank him. He has retired from ADL but now operates Hegeman Associates out of his home. . . . **Gordon Beals** and his wife attended the full reunion. Complete details are lacking, but between 1989 and 1992 Gordon left his job as project manager at Electric Power Research Inc. in Palo Alto, Calif., to join Consolidated Edison Co. in New York. They now live across the Hudson River in Ridgewood, N.J. . . . **Everett Davis** has retired from W.R. Grace & Co. (in their Cambridge office); he and his wife were on hand in Cambridge and now live in Harwichport, Mass.

After 30-some years, **Dick Lindstrom** has retired from the senior staff of Arthur D. Little and now merely consults. He and Carolyn seemed to enjoy the full reunion as much as anybody. They still live in Reading, Mass. (As a footnote, the **Lindstroms** and **Coes** get top awards in the "clean plate" club!) . . . Martha and **Jim Mast** drove east from Grosse Point, Mich. (that's dedication!) and feted our four-

day reunion. Both are still active with Jim's construction business, the Walter H. Mast Co., and are youthful and happy.

Jane and **Gil Gardner** celebrated on campus and at the Cape, and now Gil has *really* retired (the first time from the Air Force and now from the senior staff of Analytical Services or ANSER). The latest word is that he is "loving retirement," that they have 10 grandchildren (and are still counting), and that Jane has left a 25-year career as real-estate broker and manager to become certified for HIV/AIDS instruction in the workplace. . . . After what seems like aeons, **Mark Schupack** joined us for part of the campus festivities. He has settled back to being a plain ole professor of economics at Brown University, after serving "tours" as department head and dean—enthusiastically, I presume.

Dorothy and **Dick Simmons** were unable (for business reasons) to stay beyond the campus part of the reunion. Dick delivered our record-breaking gift at the T-Day luncheon *and* gave the best (and shortest) speech. He is chair of the board of Allegheny Ludlum Steel Corp. in Pittsburgh but lives in Sewickley, Pa. (on a 12-acre lot). I forgot to ask: Do you mow it yourself?

Jackie and **Bill Gouse**, both looking handsome and the latter topped with terrific white hair, stayed through most of the reunion, cutting a day short with a flight to Europe. Bill is senior VP and general manager of the Civil Systems Division of MITRE Corp. in McLean, Va., but will be retiring in December. They recently finished building a new home on their farm about 50 miles southwest of Washington, D.C. And Bill says that *he* mows their 12 acres of lawn. Impressive—don't you agree, Dick? . . . Elizabeth and **Bill Peet**, still living in Allenhurst, N.J., where Bill is president of Peet Brothers Company, attended all of the reunion. They are still a tall, attractive couple and good company.

This 40th Reunion review will be continued next month. But do not forget to send news, whether politically correct or not.—**Martin Wohl**, secretary, 4800 Randolph Dr., Annandale, VA 22003, (703) 354-1747

# ClassNotes

## 54 40th Reunion

Plans for our 40th reunion continue to develop. By the time you read this, you should have received new information from **Bob Warshawer**. If you lost it, forgot it, or didn't understand it, here's a summary: Wednesday, June 1: Reception at President and Mrs. Vest's home, followed by dinner at Tecce's in the North End, with music by Jay Kaiser's band. Thursday, June 2: Bus tour of Boston for those inclined, pre-Pops dinner on campus, Pops concert, post-Pops dessert at MIT Museum. Friday, June 3: T-Day on campus, dinner at the Boston Harbor Hotel. Saturday, June 4: Leave for Nantucket Inn, clambake dinner. Sunday, June 5: Enjoy Nantucket, evening dinner dance. Monday, June 6 (or later if you prefer): leave for home. If you haven't signed up yet, let us hear from you.

Moving to news of the class, we have received word that **Bob Brown** has retired as president and director of Belding Hemingway Co., Inc., in New York City. . . . And last October, **Phil Sayre** was recognized for his contributions to MIT. He received the Bronze Beaver Award, the highest honor bestowed by the Alumni/ae Association. Congratulations, Phil!—**Edwin G. Eigel, Jr.**, secretary, 33 Pepperbush Lane, Fairfield, CT 06430

## 55

**Al Wechsler**, senior VP and CPO of Arthur D. Little, Inc., has also become president of the Arthur D. Little Management Education Institute. The institute is located on the ADL campus in Cambridge and grants the degree of MS in management. Most of the students are middle managers from overseas. As a senior VP of ADL, Al is responsible for the quality of client work and new product development.

News has been thin these last few months—let one of us know what you are doing and start planning now to attend our 40th reunion. Hard to believe that it's only 15 months off.—Co-secretaries: **Roy M. Salzman**, 4715 Franklin St., Bethesda, MD 20814; **James H. Eacker**, 3619 Folly Quarter Rd., Ellicott City, MD 21042


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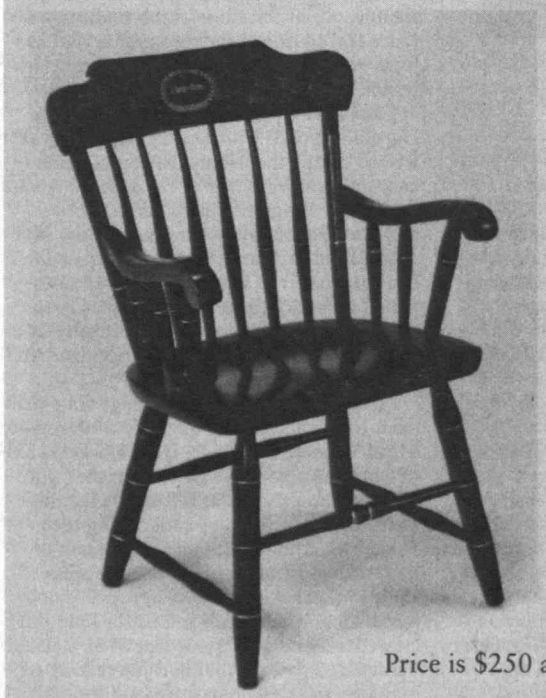

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## 56

At the Alumni/ae Leadership Conference held on campus October 2, 1993, Ruth and **Lloyd Beckett** met with several classmates as follows: **Paul Cianci, Margi Gilson, Bill Grinker, Dick Jacobs, Bob Kaiser, Bill Northfield, Wendell Rice, Jack Rosenfeld, Harris Weinstein,** and **Sven Vaule**. Lloyd reported that the conference was very informative. In addition, the group discussed the upcoming reunion. Please send news to **Ralph A. Kohl**, co-secretary, 54 Bound Brook Rd., Newton, MA 02161

## 57

**John Collins** writes that he has celebrated the fifth anniversary of his company, Cow Creek Enterprises, Inc. The company specializes in high voltage power conversion and is located in Azalea, Ore. . . . **Ben Edwards** is currently working in his own one-man laboratory, formulating and testing coatings for concrete. He writes that it is almost as good as retirement. He walks 200 yards through the woods to go to work. He and his wife have raised 9 kids—from merged families—and have 10 grandchildren. They are now being recycled as parents to a 7-year-old granddaughter. The Edwards family, laboratory, et al., are located on the Blue Ridge Parkway near the highest point in the Appalachian Mountains.

**Harold Smith** is now an assistant to the Secretary of Defense, responsible for the planning, modernization, security, and survivability of the nuclear stockpile. He oversees programs for chemical and biological defense, destruction of nuclear weapons, acquisition of counter-proliferation technology, and management of arms control treaties. He also has responsibility for implementing programs for the safe and secure dismantling of weapons of mass destruction of the former Soviet Union. He chairs the NATO Senior Weapons Protection Group. Hal was formerly the president of Palmer Smith Corp. and was the founder and director of Swerling, Manase & Smith, Inc., a Los Angeles firm that analyzes recent advances in radar systems. From 1970 to 1976 he was a member of the faculty of the University of California.

**Bill Doughty** retired from Polaroid in July 1993. After getting a master's degree in education and looking into secondary education in mathematics or science, he decided to retire in earnest. He and Marge have sold the house in Wayland and moved to a house built by his great-grandfather on Orr's Island, Maine—near Bowdoin College. They spent three years renovating the house, which Bill describes as "quite unimproved." It is now about finished. **Hugo Liepmann** visited them in 1991 and 1992. Other classmates are to be welcomed.—**John Christian**, secretary, 23 Fredana Rd., Waban, MA 02168

## 58

Please send news for this column to:
**Mike Brose**, secretary,
75 Swarthmore St.,
Hamden, CT 06517

## 59

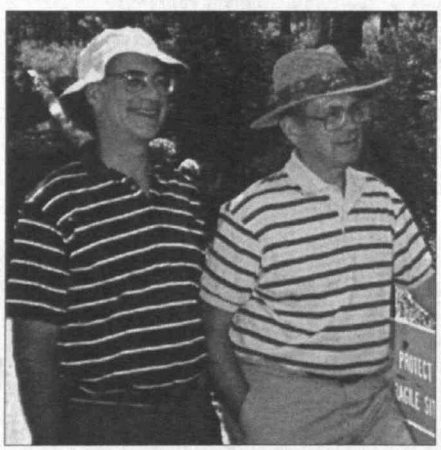
## 35th Reunion

The classnotes deadlines seem to be compressing at this time of year, so the unreported mail is more limited than usual this month. Let's quicken the pace to keep the column full!

There is a good card from **Bob Manlove** in which he reports, "I was recently chosen dean of the School of Science and Mathematics at City College of San Francisco. This includes the Departments of Engineering, Physics, Earth Sciences, Chemistry, Astronomy, Biology, Computer Information Science, Mathematics, and Architecture. Currently, we are beginning a program to produce middle-level management for engineering and architectural firms...also we are looking for Bay Area scientists and engineers who would like to serve on the School of Science and Math Advisory Council." Bob's return address is Lafayette, Calif., and he notes his long string of degrees culminates with "PhD at last in 1990."

Reunion planning continues at a good pace, and you have already received communications on this leading off with a great picture of the Black Point Inn.

By popular demand, here is the photo of classmates **Larry Boyd** and **Dix Browder**, cited in a recent column. As I recall this was at a golf outing somewhere in Oregon.



*As promised: Fifty-Niners*
*Larry Boyd and Dix Browder*
*Central Oregon, July 1993*

That's all for now. Again, especially now, I urge you to **actually do it**—to send an update which will be much appreciated by your classmates, and to stimulate other classmates to do the same!—**Dave Packer**, president, 31 The Great Road, Bedford, MA 01730, (617) 275-4056

## 60

For the second issue in a row, your secretary is experiencing a slow news month—help!

**Robert White** writes that after three years in President Bush's Administration as Undersecretary of Commerce for Technology, he has joined Carnegie Mellon University as professor and head of Electrical and Computer Engineering. Bob says, "By the end of the administration, we had transformed the Bureau of Standards into NIST, an organization with the new mission to support competitiveness of U.S. industry by launching the Advanced Technology Program and establishing seven regional manufacturing technology centers. The National Technical Information Service was revitalized, and numerous technology programs were initiated. I feel we accomplished a great deal in spite of the industrial policy shadow." In recognition of his accomplishments, Bob was recently awarded the IEEE's Public Service Award. Congratulations Bob, and continued success in your new position.

A recent issue of the *Wall Street Journal* noted that **Thomas Pyle** was named CEO of MetLife HealthCare Corp. in Westport, Conn. Much success to you, too, Tom.—**Frank A. Tapparo**, secretary and class agent, 15 S. Montague St., Arlington, VA 22204

## 61

Please send news for this column to: **Andrew Braun**, secretary, 464 Heath St., Chestnut Hill, MA 02167 or via internet: andrewb820@aol.com.

## 62

In case you didn't notice, **Hal Taylor**'s brother, Joe, won the Nobel Prize in physics for his discovery of the binary pulsar with his graduate student, Russell Hulse. Hal is quite proud of the recognition for his brother's work. I sent Hal an inquiry on the Internet for a bit more information and this is what he sent to me: Hal's brother is Joseph H. Taylor, Jr., now a professor of physics at Princeton. Joe graduated from Haverford in physics in 1963, and earned a PhD from Harvard in 1968 or 1969 (Hal wasn't sure of the date). The work that earned Joe the Nobel Prize was done while he was a new faculty member at U. Mass/Amherst in 1972–73, and the paper based on this work was published in 1974. Sometimes it takes a while to realize the true significance of certain research findings—we share Hal's pride in the recognition that has finally come to Joe for that important contribution to his chosen profession.

Classmate **Concordia Chen** received the Harold E. Lobdell '17 Distinguished Service Award during the Alumnae/Alumni Conference on October 2, 1993. The Lobdell Award is given in recognition of valuable alumnae/alumni relations service to the MIT Association of Alumnae and Alumni or the Institute that is of special depth over a sustained period of time. Concordia has been quite active and obviously very effective as a member and regional coordinator of the MIT Educational Council.

I received an interesting message via e-mail from **Jim Draper**. Since our MIT 30th reunion **Mead Wyman, Bill Koch, Dave Korkosz, Keith Glick,** and Jim have gotten together. Jim reports that his work at KTAADN includes aircraft identification by radar using their "blue collar" method, rapid assessment of leukemias, lightning forecasting for space shuttle launches, satellite design, and cloud forecasting in the South Pacific. In June Jim crewed a friend's 40' sloop out of St. Lucia for Bermuda, a passage that had Jim talking to himself—and definitely scared—during his

watches in a big blow 300 nautical miles SE of Bermuda. In August, Jim, Jane, and their daughter Allison joined their son, Stark, in Tirane, Albania, for a visit. They found the people of Albania wonderfully welcoming (and not all relatives) in a materially poor land that will be some time recovering from the ravages of its communist regime. At the outset of a cross-country bus trip, Jim asked the driver (one of two, since one was necessary to hold the stick shift in place during long mountainous descents that were interrupted by stops to pour water over hot brakes), "When do we get underway?" "Oh," sez he, "when the bus is full!" Jim notes that Albania might replace Southern California as the capital of "Mellow"! The summer adventures ended on a grace note at Bill Koch's Cape Cod establishment where the gang had the pleasure of sharing the first America's Cup reunion with many friends including Bill Roeseler, '65, Bill Unkel, Jerry Milgram, '61, and Harry Lee, '57. Jane and Jim wish their many MIT friends a good wind and fair seas.

I also received a final e-mail message from **Dave Bragdon**, as follows: Dave got out to Ann Arbor, Mich., in October, to see son, Jeremy, who is in his junior year in pre-med studies. He hauled Dave off to a biochemistry lecture on lipids. Dave noted that the professor had a good sense of humor, but his dry jokes were received with the same note-taking absorption as his description of esterification. What seemed missing in the big lecture hall, as compared with classes 30 years ago at MIT, was the absence of hissing at the professor's jokes. Dave wants to know if hissing at jokes has survived at the Institute or has it become another victim of PC? Dave and family visited with Bev and **Jack Walker** for a delicious supper at their home on a hill above the Huron River. Jack had returned from a trip to Washington, D.C., where he attended a meeting as a member of the U.S. Air Force Scientific Advisory Board. Bev was back from delivering paintings to art galleries, where her work is experiencing increasing demand. They were joined by the Walker's daughter, Jacqueline, a mathematician in charge of performance metrics at Prudential. Also at the supper table (although not seated) was Daisy, a Great Dane, who occasionally rushed off with awesome commotion to bark at deer or pheasants visiting the garden. Dave is working at Digital, in Littleton, Mass., for DECathena Engineering. DEC has just released DECathena on CD-ROM. According to Dave, "It has the soul of MIT Athena, but has been ported to numerous vendor platforms, and now has a Graphical User Interface and a self-installing kit (well, almost)."

While snail mail from our classmates seems to be as rare as laughter in biochemistry classes, the e-mail system is providing us with interesting and timely insights on our classmates. If you have access to the Internet, please put a message through to: MIT1962@mitvma.mit.edu If you can still communicate by written methods, please send your news and personal notes to: **Hank McCarl**, secretary, P.O. Box 352, Birmingham, AL 35201-0352

P. S. We appreciate the notes and messages from classmates and friends of MIT 1962—please keep in touch with your news so that we can share same with our other classmates. I hope this service is useful to you, because it sure helps me get news for our class notes.—HMcC

# 63

The Alumni Leadership Conference was held the first weekend of October at Tech and was the first time back at MIT for me since our reunion. That Saturday, two of our members received awards at a luncheon presentation. **L. Robert Johnson**, VIII, received the Harold E. Lobdell '17 Distinguished Service Award. It is given in recognition of valuable alumni relations service to the Association of Alumni and Alumnae and/or the Institute that is of special depth over a sustained period. **John K. Castle**, XIV, was presented with the Henry B. Kane '24 Award in recognition of exceptional service and accomplishments in fund raising for the Association and/or Institute. I'm sure that most, if not all, of us are aware of their work. These awards are well-deserved. Congratulations!

I was struck by the fact that one of the themes that kept coming up during the weekend programs was that, more than ever, the Institute has to scramble for money for so many of its projects. This did not come across as being an intentionally made point, it was just that whenever someone talked about work that they were doing or that the Institute had planned, the subject of difficulty of funding was mentioned in a way that indicated this is a concern which is now always on their mind. Government funding has been severely cut back. When we were at Tech 30 years ago, it seemed like they had money for everything. Now, hardly a project is mentioned without some allusion to how to pay for it. I don't want to get involved with fund-raising, but you might want to remember this when someone calls asking for a contribution.

In other alumnews, **James A Champy**, I, has been become corporate vice-president and president–Commercial Consulting Group, for the Computer Sciences Corp. in Cambridge. He had been senior vice president of the Consulting Group. He is also chairman and CEO of CSC Index, Inc., also in Cambridge.

**Marco Falcon** wrote to say that he has "translated parts of [*Technology Review*] articles for personal use." He got both an SB and SM in Course I in '63, but feels he really belongs to the class of '62. Marco's address is Marco A. Falcon Ascanio, Apartado 47724-1041-A, Caracas, Venezuela.

Finally, **Phil Marcus**, who is finding out that even though he retired as class secretary, he is still receiving information, forwarded 37 pages of material from **Harold Solomon**, VIII. I said send in information about what you have been doing since graduation, but 37 pages? Actually, Harold's material is really meant to support his perception of Japanese discrimination against foreigners in both universities and research programs and how it has prevented him from pursuing his research goals in oceanography during his last 21 years in Japan. (His special interest is in the Kuroshio, the Pacific "Gulf Stream.") He is appealing to various agencies, including the U.S.-Japan Task Force on Access, and would probably like to hear from you if you have had similar problems. I just happen to have his address at my fingertips also; it is Dr. Harold Solomon, Planet Nagayama No. 106, Kotta 1503, Tama Shi, Tokyo 206, Japan.

Keep the alumnews coming! Try to get it to Tech or me by the first of the month. You can reach me by snail mail: **Shoel M. Cohen**, PhD, Dept. of Psychology, Nassau Community College, Garden City, NY 11530 or e-mail: Internet 71271.2627@compuserve.com or Compuserve 71271,2627. You can also call me at home at (516) 489-6465. It would be great to talk to you personally.

# ClassNotes

# 64 30th Reunion

Plans are well under way for Technology Day and our 30th Reunion, scheduled to be held on the campus June 1-5. By the way, I'm still looking for a volunteer to take on class secretary chores for our fourth post-graduation decade.

In response to a brief item that I included in an earlier column about publication of his new textbook, **Don Danielson** wrote that he had recently experienced another professional thrill—returning to give a talk at MIT, his first speaking opportunity on the campus since his senior thesis defense 30 years ago. Don is hoping to attend the reunion, which would also be a first for him.

The Alumni/ae Association announced that **J. Michael Morrison** received the George B. Morgan '20 Award at the Alumni Leadership Conference last October. The Morgan Award is given in recognition of sustained excellence in all aspects of Educational Council activity.

**Glenn Larson** has joined Sanford Rose Associates, a national executive search firm, as director of its San Antonio office. Glenn's career has included management and executive positions with Sweda, Chorus Data Systems, Digital Equipment Corp., DATACHECKER/DTS, and Datapoint Corp. His wife, Ellie, is co-director of the office.

Louise and I are busily planning a wedding for daughter Jennifer. As I'm writing these notes, we still have not defined the date and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location, but we are approaching closure. At least the identity of the groom does not appear to be in question. The whole process is giving us a greater appreciation for what we must have put our parents through.

Please send your news and notes.—**Joe Kasper**, secretary, RR 2, Box 4, Norwich, VT 05055

# 65

Please send news for this column to: **George McKinney**, secretary, 33 Old Orchard Rd., Chestnut Hill, MA 02167, (617) 890-5771

# 66

Not a lot of correspondence, e-mail or otherwise, this month. Ran into **James Edgerton** at an alumni reception at MIT. He has his own consulting firm but spends more of his time as the volunteer National President of his old MIT fraternity, Chi Phi. He is an ambassador of sorts for the fraternity and does a lot of traveling to other schools. . . . **Richard R. Hawkes** has become vice-president of News America Publishing, Inc., in New York City. . . . There is an MIT Alumni Award program which recognizes high school juniors for outstanding achievement, especially in math and science. Seven awards were sponsored this year, four in California high schools by **Bert Forbes**.—**Eleanore Klepser**, secretary, 84 Northledge Dr., Snyder, NY 14226-4056, e-mail: vismit66@ubvms.cc.buffalo.edu

# 67

Please send news for this column to: Sharlotte and **Jim Swanson**, co-secretaries, 878 Hoffman Terrace, Los Altos, CA 94024

# 68

We guess that the flurry of reunion activity and fund-raising exhausted people so much that we are hardly getting anything in the mail. Hopefully, the start of a new tax year will start the flow again; remember that you can always write directly.

**Ray Paret** followed up on the reunion with a nice note. He points out that all ten Pi Lamda Phi members in our class managed to get to at least part of the reunion, while six were present for all events. He further points out that two of his brothers came quite long distances: **Rich Ehrenkranz** from South America and **Lenny Schrank** from Belgium. . . . **Alan Covey** has joined the medical staff at Porter Hospital, Middlebury, Vt., in internal medicine. He studied medicine at the University of Vermont and interned at University of California, Davis. After practicing family and emergency medicine for fifteen years, he completed a three-year program in internal medicine in Cooperstown, N.Y. Alan, Wendy, and their two children live in Middlebury.

**Miriam Lucian** is living in Seattle, where she is a senior mathematician with Boeing. After graduation, she attended the school up Mass. Ave. for an S.M. and a doctorate. . . . As we are writing this on Halloween, it is interesting to note that **Robert Hendel** is a general surgeon at Transylvania Community Hospital, Brevard, N.C., where he and Kathleen are living. He received an MD in 1972 from University of Connecticut. . . . **Arthur Glassman** left Cambridge for an SM in '73 from Yale and a doctorate in '77 from Columbia. He's now in sunny San Diego where he's a senior software engineer for Superset.

Probably our northernmost classmate, **Charlotte Babicki**, moved to Yellowknife, Northwest Territories, in 1972, becoming a Canadian citizen in 1977. Her career has been with the territorial government and she is now a policy and planning officer. Quilting is a major hobby and she has made 29 baby quilts for friends and relatives. . . . Closer to Boston, Radia and **Mike Speciner** have settled in Acton, Mass., where he is lead architect for CAMEX, Inc., a firm active in databases, imaging, and communications. They have two children—Dawn, 14, and Ray Alexander, 11.

We still have a few copies of the reunion yearbook with photos and bios of many classmates and addresses of all. If you'd like a copy, send a check for only $25.—**Gail** and **Mike Marcus**, secretaries, 8026 Cypress Grove La., Cabin John, MD 20818

# 69 25th Reunion

Our 25th class reunion is fast approaching—June 2–5, 1994. Please reserve those dates for an outstanding time!

Since I did not receive notes from you folks, I decided to post an entire, wonderful letter in from **Robert J. "Sandy" Randall**. Robert wrote me, "You may or may not choose to consider this letter as 'news' and it will not offend me in the least if you simply throw it out. I have no good explanation for writing it, but I am." Here is Bob's letter, in which we all might find parallels in our own lives these past 25 years:

"During the first decade after graduation, I worked for General Dynamics/Electric Boat. Some very challenging times, some very boring times, and never enough vacation. My dream was to someday retire and be a freelance engineering consultant. The second decade saw me as chief engineer of one steel fabricator, general manager of another, director of engineering in sporting goods manufacture, and chief engineer at Lord & Burnham. When they closed down their greenhouse manufacturing division, I decided I had enough of the fickle world of industry and started Randall Engineering.

"You and our classmates are among a very small minority who can appreciate the true significance of the integral in my tongue-in-cheek logo; few realize that it is just a little private joke. [Editor's note: Bob's logo is the integral of 2x and x from the limits x=10 to x=13. As you all know from 18.01, that is 69!] But anyway, I have achieved that dream and since 1986 have been as busy as I want to be doing mostly fun stuff in my private practice here in this suburb of Shrub Oak, N.Y. I have designed houses, septic systems, bridges, and many a residential addition. A rush job on an unusual 1,000-ton jack for JPL only 1-inch high was one of the more exciting design projects. Currently my work includes building maintenance engineering, new construction design, general construction problem consultation, nationwide greenhouse and solarium design consultation, and even publishing the

occasional article in *Journal of Light Construction*. Work is fun, I make my own hours, and I have no intention to expand unless one of my children chooses to join me."

"I wanted to mention my children. When Chris applied to the 'Tute, with some pretty impressive credentials, he was turned down. I was a bit taken aback and inquired of the admissions department how he fell short. They told me it was not that he didn't meet their standards; they just didn't happen to pick him. A few days later I received a letter from the director of the Alumni Fund asking permission to use my name and exemplary record of contributions (Great Dome Associate) in their publications. Go figure."

"So Chris went to Brown, and Tim just started at Yale. And the 'Tute doesn't ever get another dime from me. Is this experience normal? Jennifer and Samantha don't seem to be headed in the same directions, more leaning toward education and medicine at the moment, but at 11 and 13, who knows? They are responsible for one of the more unforeseeable developments; I am now president of the Northern Westchester Symphony Orchestra. (We need musicians; any locals interested?)"

"I am reporting with deep regret the recent passing of a dear friend (and father-in-law to Bob MacDonald, '68) Ferdinand Johnson, '33, who died in Albany on September 3. His active retirement years set a wonderful example for anyone, as did his tireless dedication to his family. We will miss 'Pop-Pop.'"

"Well, Mr. Mallove, that's all there is. I wish for you that your life should be full of the happiness and love that my family give me, and your retirement should be as rewarding. Sincerely, Sandy."

Let's have more great letters like this one from Bob Randall and let's see you all at the reunion!—**Eugene F. Mallove**, secretary, 171 Woodhill-Hooksett Rd., Bow, NH 03304

# ClassNotes

## 70

Please send news for this column to: **Greg** and **Karen Arenson**, secretaries, 125 W. 76th St., Apt. 2A, New York, NY 10023

## 71

Please send news for this column to: **R. Hal Moorman**, secretary, P.O. Box 1808, Brenham, TX 77834-1808

## 72

**Les Harmer** started with our class, but like myself and many other classmates graduated a year later, in his case due to taking a year off. Still we consider ourselves part of the class of 1972. Les married his fifth grade sweetheart on April 25, 1992, but forgot to tell me her name. He is an attorney in solo law practice, presumably in Rochester, N.Y., where he makes his home. He and his wife now have a baby girl, Katherine Mieka Harmer.

**Craig Melin** continues as president and CEO of Cooley Dickinson Hospital in Northampton, Mass. He has also joined the board of trustees of the Massachusetts Hospital Association, which represents the interests of acute and specialty hospitals in the state.

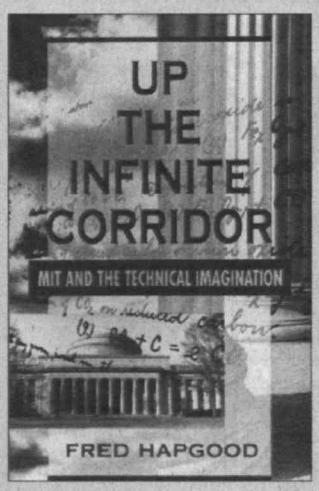
Well that's it for now. We had very little news this month, so please be sure to keep sending in your news!—**Wendy Elaine Erb**, co-secretary, 6001 Pelican Bay Blvd., Apt. 1001, Naples, FL 33963

## 73

The lone note of interest this issue comes to us from Lincoln, Mass., where **Peter Guldberg** writes: "My wife Alex and I are thoroughly enjoying our new son Matthew, who is approaching his second birthday on Halloween. Children are a great tonic for the stress of today's society. My environmental consulting firm, started back in 1984, continues to prosper."

So may we all. I am starting my second year as an MIT educational counselor, interviewing prospective 'Tute folk; Boy Scout JR just made first class scout, Eric is wrestling with his second year of college, and Ruth and I are well. Good Lord, that makes us sound like we're in our 60s! Better cheer us up in our declining years—write!—**Robert M.O. Sutton, Sr.**, secretary, "Chapel Hill," 1302 Churchill Ct., Marshall, VA 22115


# TAKE A TRIP UP THE INFINITE CORRIDOR

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# 74 20th Reunion

Please send news for this column to: **Lionel Goulet**, co-secretary, 115 Albemarle Rd., Waltham, MA 02154-8133, (617) 899-9694

# 75

Apologies for missing the last couple of columns, but news has been incredibly sparse. Isn't anyone doing anything? **Steve Slesinger**, bless him, took pity on me and our empty class notes column by writing, "Well, I'm tired of looking at our empty entry in *Technology Review*, so I thought I'd drop you a line. I cashed in some frequent flier miles and returned to MIT after about a decade away from Boston. The MIT Media Lab sponsored a day of lectures honoring Marvin Minsky of the Artificial Intelligence Lab. The symposium, 'Society of Minds,' featured Arthur C. Clarke, Seymour Papert, Danny Bobrow, David Waltz, Oliver Selfridge, and others. One of my favorite talks was entitled "If the Human Mind is a Kludge, How Do We Build One?" It was a fantastic, stimulating day. I had lunch with Jerry Lettvin and Jerome Wiesner—hard to top that! Lots of memories being back at the Institute. Lots was the same, and lots had changed. Enough rambling. . ."

**John H. Erdman, Jr.** received the Harold E. Lobdell '17 Distinguished Service Award. Awards were announced during the Alumni/ae Leadership Conference on October 2. The Lobdell Award is given in recognition of valuable alumni/ae relations service to the Association and/or the Institute that is of special depth over a sustained period. . . . From a clipping from the July 8, 1993, *Cambridge Chronicle*, I learned that **James C. Leung** was appointed vice-president of process development with Repligen Corp. Jim will continue developing manufacturing procedures for Repligen's efforts against cancer, viral disease, inflammatory disorders, and cardiovascular conditions. Products in three of these areas are currently under study in the human clinical setting and the fourth product will be tested later this year.

Finally, I received some interesting materials about **Marshall Burns** who has authored a book entitled *Automated Fabrication, Improving Productivity in Manufacturing*. The book describes new technologies for generating three-dimensional objects (made out of photosensitive plastic polymers) from computer files, i.e., "desk-top manufacturing." Marshall's company, Ennex Fabrication Technologies in Los Angeles, advises corporations on automated fabrication and its uses.

That's all for now. Let's hear from more of you!—**Jennifer Gordon**, secretary, c/o Pennie & Edmonds, 1155 Avenue of the Americas, New York, NY 10036, or 18 Montgomery Place, Brooklyn, NY 11215

# 76

We have hit new lows with respect to news. In the two months prior to the publication deadline for this column, your secretary did not receive a single phone call, letter, note, fax, e-mail, or whisper of news. Please write, *now*, so that an empty column does not become the hallmark of the Class of '76!

As for your seretary, I am on a consulting project in Boston, of all places. It is highly ironic, in that I moved to New York for business reasons, and now find myself doing some consulting in my hometown.

Our last exhortation. Write!—**Arthur J. Carp**, secretary, Quantalytics, Inc., 220 Henley Rd., Woodmere, NY 11598-2523, (516) 295-3632, Fax: (516) 295-3230

# 77

Please send news for this column to: **Ninamarie Maragioglio**, secretary, 8459 Yellow Leaf Ct., Springfield, VA 22153-2522 or e-mail to hertz@xip.nrl.navy.mil

# 78

Please send news for this column to: **Jim Bidigare**, secretary, 9095 North Street Rd., NW, Newark, OH 43055-9538, (614) 745-2676

# 79 15th Reunion

Another slow news day—I have only one item to report. **Rick Kovalcik**, our class agent, has been awarded the Henry B. Kane '24 Award by the MIT Association of Alumni and Alumnae. The Kane Award is given in recognition of exceptional service and accomplishment in fund-raising for the Association and/or the Institute. . . . That's it for this month. That makes two months in a row with little to no news. This is going to be a pretty boring column from now on if some of you don't get off the stick and drop me a line.—**Sharon Lowenheim**, secretary, 98-30 67 Ave., Apt. 6E, Forest Hills, NY 11374

# 80

Just one note this month. **Charles White** received a PhD from MIT in 1988 after a stint in the Army. He has begun an academic career at Northeastern University as an assistant professor in mechanical engineering. Prior to this he worked at a government laboratory and in industry. Charles has been married for four years to a wonderful pianist and they have a delightful 2-year-old daughter.

Send your news to: **Kim Zaugg**, secretary, 549 Fairfield Road, Canton, MI 48188, vayda@erim.org

# 81

Yes, we do have some news this month—all of it good:

*Love, Italian style.* A big *Auguri!* to **Adrienne Catanese**, who spent about 10 days in northern Italy last September and came back engaged. Her boyfriend, Chris Baker, popped the question on the Italian Riviera, and they've set the date for May 14, 1994. *Che bella!*

*CAD Hegemonist.* We are informed that **Charles Garrett** has opened a front in the CAD theater of action with the creation of the Computer Technology Group. He's marketing

interfaces for Microstation and Cybase SQL servers, and is doing quite well. Charles would be glad to hear from classmates by e-mail, where he can be reached at ctg@hegemony.chi.il.us.

*Historic achievement.* Congrats to **Thomas Misa,** associate professor of history at the Illinois Institute of Technology, who was the recipient of the 1993 Bauer Family Excellence in Undergraduate Teaching Award. After graduating from the Institute with an SB in chemical biology, Thomas received a doctorate in history and sociology of science from the University of Pennsylvania. He's been teaching history for over 10 years, since 1987 at IIT.

*Numerology.* **Jay Walsh** has observed a certain mathematical aspect in his life. It's been 12 years since graduation, after 11 total years at MIT ('77–'88), and now 10 years of marriage, nearly 9 of them with kids. He's lived in 8 different residences. He was in grad school for 7 years (SM in electrical engineering and PhD in history). Now he investigates medical applications of lasers, runs conferences, and at last count has had 6 major grants (including an NSF Young Investigator Award). He's been on the tenure track at Northwestern University, Biomedical Engineering Department, for 5 years. He has 4 wonderful children (Christopher, 8; Jennifer, 6; Michael, 3; and Kristina, 1), 3 ridiculous pets, in a life with "2" much stress, which, however, is made quite bearable by 1 fantastic wife, Karen (Wellesley, '82; Tufts Vet, '86).

Finally, I've received some information concerning the activities of the Class of 1981 Student Financial Aid Fund. The 1992–93 recipients were Cora Dancy and Joseph Karlin. Cora was in the chemical engineering five-year master's degree program and this past summer was finishing up her thesis at Dow Chemical in Michigan. From there she's on her way to University of California Santa Barbara for a doctorate. Joseph is now a senior and mechanical engineering major, as well as an accomplished musician who hopes to complete the additional requirements for a music minor. Thanks to those who've made this possible.—**Mike Gerardi,** secretary, 3372 Olive St., Huntington Park, CA 90255, (310) 553-5050 (work), (213) 587-2929 (home)

# 82

Only one item this month, **David Mustelier** writes that he is alive and well and surviving the California recession.—**Helen (Fray) Fanucci,** secretary, 502 Valley Forge Way, Campbell, CA 95008; pdalady@AOL.com

# 83

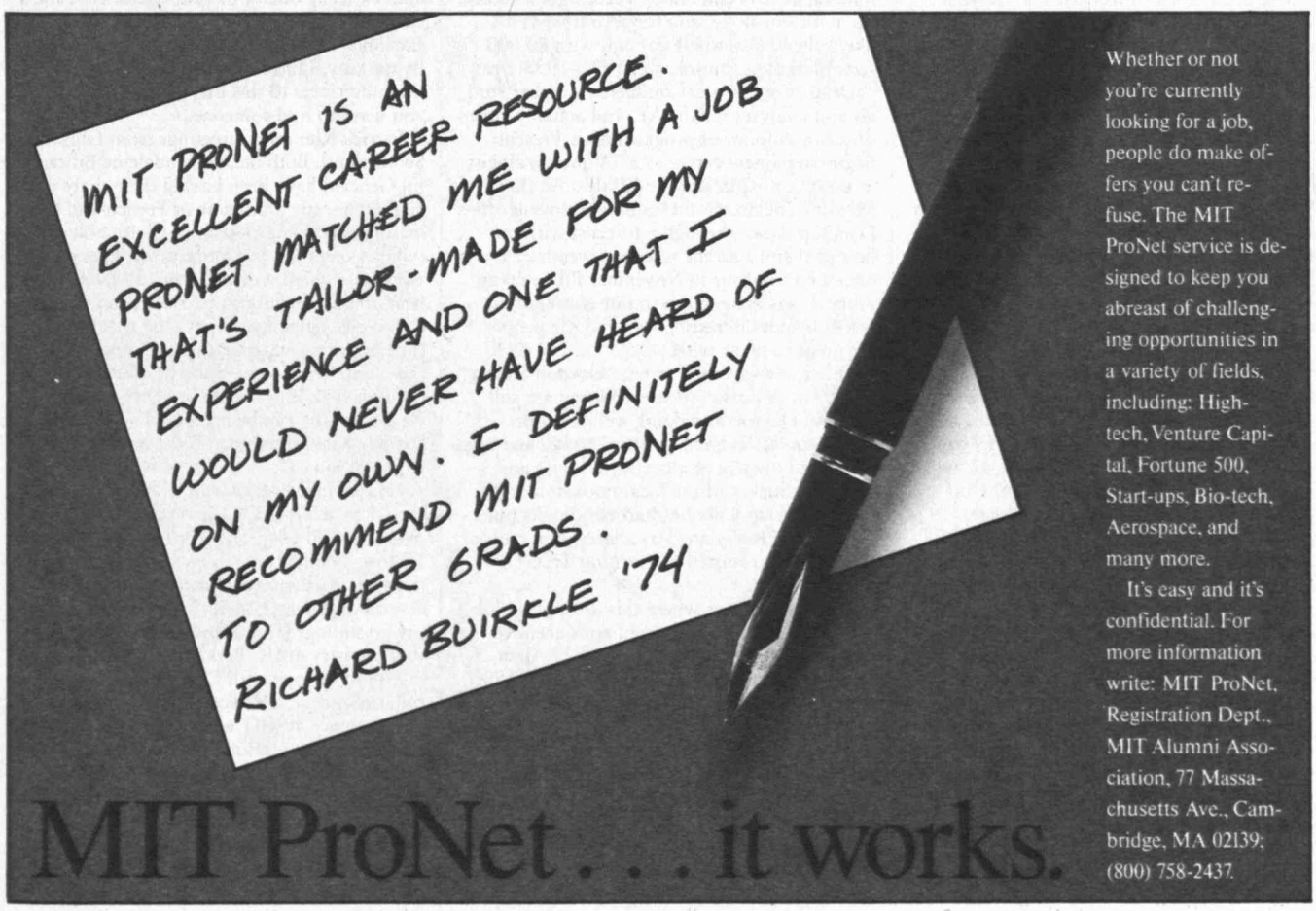
This month's column is full of news from Cincinnati. **Dave Dombrowski** writes that he and his wife, Nancy, and their two sons have moved to Loveland, Ohio, just north of Cincinnati. Dave is now manager of Service Inspection Technology for GE Aircraft Engines, where he is responsible for development and application of non-destructive inspection technology. Nancy has temporarily suspended her court reporting career for a more rewarding one in child development.

Our most famous classmate from Cincinnati, Vice-President **Arlene F. Taylor,** received the Harold E. Lobdell '17 Distinguished Service Award. The award was announced at the Alumni/ae Leadership Conference at MIT on October 2. The Lobdell Award is given in recognition of valuable alumni/ae relations service to the Association and/or the Institute that is of special depth over a sustained period.

It's your class secretary's policy that anyone who wins a Lobdell Award is obligated to write the rest of the column. Arlene's contribution is as follows: "Still getting to know Cincinnati, but I did spend some time trying to track down other '83ers. My directory lists the following: **Brian Barkocy** working at Procter & Gamble, **Barry Jordan** working at a construction firm (are you a founder/owner, Barry?), **Henry Lin** and **John Ray**are also here, but prefer not to be contacted at home. As a new Cincy resident, I wouldn't mind hearing from any of you.

"I attended the Alumni/ae Leadership Conference in October and ran into a few classmates. All of the class officers were there except you (Jonathan) and we spent additional time over breakfast talking about our plans for the next five years. Of the folks I saw, **Sarah Bingham** wins the 'doing what MIT

# ClassNotes

taught us to do award.' After attending an ILP forum last year, Sarah proceeded with bringing together an MIT professor and business interest to start a new firm. . . . **Elaine Martel** has two master's and is now being sent to law school by her company. She also bought a two-acre homestead in Marlboro.

"The 'Lost in Space—And Found' award goes to **Kevin Churchwell**. He's on staff at Children's Hospital in Boston, is married and enjoying a new baby girl born this past May. . . . **Clint Wright** returned and finished his degree in '89. He's married and has a girl too."

Thanks for writing, Arlene. Please note the new address below.—**Jonathan Goldstein**, secretary, TA Associates, High Street Tower, 125 High St., Suite 2500, Boston, MA 02110

## 84 10th Reunion

Hold June 2nd through the 5th for our 10th Reunion. The committee geared up at the Alumni Leadership Conference back in October and is preparing for your arrival. Come back to Cambridge. Toscanini's is still there and so will all your old friends (some having even left in the interim).

**Steve Ellison** is the proud father of baby Rachel, now about 16 months old. He is working for H-P's disk-drive manufacturing facility in Boise, Idaho. . . . **Dave Serafini** left California, where he was consulting with NASA at the Ames Research Center. He has moved to Houston, where he started in the PhD program in computational science and engineering at Rice University. Dave says it has been a difficult transition going back to being a student again after so many years. He is still involved in theater doing backstage work, just like at the 'Tute.

**John McCrea** received an MBA from Stanford in June of 1993. He had an excellent time with classmates **Michael Cation** and **Greg Hughes**. John is in business for himself. "McCrea and Company" is consulting to high tech companies on marketing and strategy issues. . . . **Chuck Markham** and his wife, Ellen, have fled Boston to the suburbs of Norwell. They bought a house there and Chuck's financial consulting is going well.

**Don Gillies** just became an assistant professor in electrical engineering at the University of British Columbia in Vancouver. He is enjoying the beaches and the mountains, and looks forward to skiing at Whistler this winter. **Michele Chan** and David Liang, '82, will be visiting Don for skiing this winter. Don considers this his reward for struggling through CS grad school in the flatlands of Illinois for the past six years. At Illinois Don was taking classes from his former housemate, **Andrew Chien**, who "had the gall to graduate and come haunt me as a CS professor at U-Illinois." Don writes that Bill Messner, '85, recently became an assistant professor of mechanical engineering at CMU. One of Bill's first great accomplishments at CMU was to form SwimNet, the electronic mailing list for ex-MIT swimmers. This list includes Coach John Benedick, John Schmitz, '82, **Bob Schoenlein**, Topher Heigham, Megan Smith, Patti Lodi, Karin Hollerbach, Don, Karen Gleason, and **Scott Doran**. Contact Bill (bmessner@andrew.cmu.edu) to join.—**Howard Reubenstein**, secretary, 28 Mitchell Grant Way, Bedford, MA 01730, (617) 275-0213 (home), hbr@mitre.org

## 85

It is a bit of a slow month for news. Fortunately, e-mail has come through to fill the gap.

**Brian White** writes, "After graduation, **Julie Schwedock** and I (MIT '85 also) went to Stanford for graduate school in biology. We both got PhDs (separately) and got married (to each other). We moved back to Boston in January 1992 and now live in Arlington. Julie is a post doc at Harvard and I'm an instructor in the MIT Biology Department. I work on 7.012/3/4, the new biology requirement courses. I'm also a freshman advisor. It is so strange to be on the other side of MIT. It's that MIT vortex that keeps drawing me back...."

From the West Coast comes the word from **Linda (Wormley)** and **Anthony Falcone** that they have a baby girl, Marissa Lynn, born July 31, 1993. Linda says that it is both challenging and thrilling to be parents. Tony is working on his PhD in math at UCLA and Linda was working as a physical therapist at UCLA Medical Center and is now on maternity leave.

Dateline: Dayton. The following chronology comes from **Warren Madden** after eight years of silence. "1985–1990: In the Air Force, assigned to Wright-Patterson AFB in Dayton, Ohio. Although my title was computer research officer, I got shoved more and more into management. Blech. 1990–1991: Decided to get out of computers and go back to my first love, meteorology. Talked the AF into sending me to Penn State, where I got a second BS in meteorology, and found out what it's like to be in a football stadium with 80,000 screaming fans. Impressive. 1991–1993: Sent back to Wright-Patt. Conducted weather studies and analyses for the AF, and actually got to do a fair amount of programming. Present: Beginning a new career as a TV meteorologist in Dayton at CBS affiliate WHIO. All that Musical Theatre Guild training is paying off—I can tap dance through a forecast with the best of them! I do the weekend weather, and once I go full-time in November I'll be doing other things around the station during the week. It's an interesting job, and the people are great to work with.

Other news from Warren: "**Gordon Strong** and his wife **Karla (Stickley) Strong** are still living in Dayton and doing well. Gordon works for TRW and Karla for TASC, and are the proud owners of a beautiful house and two cats. Survey of the local bookstore indicates that **Dan Gilly** has had two books published by O'Reilly and Associates. Not bad for someone who started out writing Tech Shows!"

Gee, who knows where this journalism job will lead?—From Pittsburgh, your ace investigative reporter, **Bill Messner**, 5927 Alder Street, Pittsburgh, PA 15232, 412.361.4180. internet: bmessner@andrew.cmu.edu

## 86

**Lee Fortunato** is still working on a doctoral degree in molecular biology at UC/San Diego. With any luck, she'll be done in about a year. She got married last October to John O'Dowd, whom she met out in San Diego. Congratulations! . . . **Andrew Stevens** is in his fourth (and hopefully final) year of the Phd program in electrical engineering at Columbia. He really likes living in New York and says being in school sure beats working for a living (you can say that again). He does work sometime—last fall, he lectured a course at Columbia similar to 6.111. He also worked at AT&T Bell Labs from 1986–1989 and Argonne National Labs (1989–1990) before returning to school. Andy's also worked summers at Analog Devices and IBM. In his spare time, he does bookings at a nightclub called the Postcrypt Coffeehouse. It's mostly acoustic folk music. Andy passed some info on about **Bobby Greenfeld**, who is at NYU Law school. Andy boasts that he's been to Senior House's Steer Roast every year since graduation.

Not much news this month—we'll have more news if you *WRITE*! I'm three weeks away from having a son or daughter.—**Mary C. Engebreth**, secretary, 21305 Arrowhead Ct., Ashburn, VA 22011, (703) 729-6568

## 87

Greetings, and hope you're having a productive winter. I've had lots of good feedback from the e-mail system—if you want to participate but your company/place of work is not yet on-line, there are commercial services which you can join, including America On-Line and MCI-Mail. In addition to having access to the MIT mailing list, you can easily keep in touch with other friends who have e-mail by using one of these services. Give me a call, and I'll give you more information (in exchange for news for this column, of course!) By the way, I have the e-mail addresses of all the subscribers to this list, so let me know if you want to find someone.

**Patrick Kim** sends greetings from Lausanne, Switzerland. Both he and Madeleine Biber, '86 (in Geneva) have been having their share of visitors, mostly alumni/ae of French and German House. Visitors such as Claire Foley, '90 (who is spending five months in Geneva doing work associated with a Cornell PhD) have been treated to outings to Yvoire, on the shore of Lake Geneva, for crêpes, and to Thonon for the best butter pastries and hot chocolate in the region. Pat offers "tourist information" (and plays tour guide, it seems) to interested classmates; he can be contacted via Internet at Patrick_Kim@dmxqm.epfl.ch, or by phone at 41-21-806-4147.

**Connie Jeffery** checks in from Brandeis University in Waltham, where she has just taken a post-doctoral position sponsored by the Cystic Fibrosis Foundation. She will be working on determining the three-dimensional structure of several different proteins by the method of x-ray crystallography. After finishing a PhD in biochemistry at UC/Berkeley, Connie spent a month in Europe with **Chris Joerg** and some other friends. Chris received an SM in computer science at MIT a few years ago, and is currently there working on a PhD.

**Chuck Davis** is surprised to find himself working in New Jersey (or so it seems from his e-mail message) for Kimberly-Clark, in the area of corporate finance. He moved to the Princeton area after finishing an MA in finance at the University of Alabama last July,

# ClassNotes

and is looking forward to meeting alums at the MIT Club of Princeton. Chuck also mentioned that **Rocky (Hamilton) Moy** recently received an MBA from Carnegie-Mellon, and is now working for Xerox in Rochester, N.Y.

**Mike Dennis** reports that he got the itch to write in after seeing his name in a recent column. (Y'all should follow his example!) He is currently enrolled in the Naval Postgraduate School in Monterey, Calif., where he is working towards a master's in aeronautical/avionics engineering, which he thinks is surprising, considering that he swore he never wanted to do engineering after surviving Course XVI. In Monterey, Mike has run into fellow ROTC alums **Chuck Chase** and David Eccles (Tufts '87). Before returning to graduate school, Mike was a naval flight officer and flew S-3B jets from the USS *John F. Kennedy*. Besides participating in Desert Storm and patrols off the coast of ex-Yugoslavia, Mike spent time in many other places, including Marsailles, where he got to celebrate his first anniversary with his wife, Susan (Ohio State '87). Besides grad school, Mike and Susan are busy with their 1-year-old son, Eric, and 2-year-old Lab mix, Misha.

I will quote **Greer Tan Swiston**'s entry directly: "On a recent trip to Las Vegas, **Rob** and I coincidentally ran into **Toai Doan, Dave Maes**, and **Krishna Komanduri**. Rob and I were out there mainly to spend time with some old friends of mine: Penny Fu, '86, Grace, '86 (my sister) and Jeff Wang, '86, Hae Jin Baek, '86 and Doug Chu, '89. Toai is working hard at his new job in Canoga Park... long hours, struggling company. Krishna was happy to be enjoying one of his very few weekends (the life of a doctor in residency...), and Dave was just happy to be able to leave Las Vegas with his shirt!"

**Michael Saylor** writes in to tell us about the company he started with classmates **Sanju Bansal** and **Thomas Spahr** in 1989. MicroStrategy is a firm of Client/Server Decision Support Experts, focusing upon systems integrating Windows, Macintosh, and UNIX clients with relational database servers such as Oracle, Informix, Sybase, and DB2. The firm has about 45 employees with offices in five cities, and many clients from the Fortune 500. Sanju is the executive vice-president, and runs the day-to-day consulting business as well as the Washington office, while classmate **Sid Banerjee** joined the company as a manager in the consulting business. Michael serves as the company president, and is hence involved in a little bit of everything, including closing that big deal! Other TDC fraternity brothers working at MicroStrategy include Ratnadeep Damle, '86, Loginn Kapitan, '85, and Mickey Wurts, '90.

As a result of last month's column, I have had a series of e-mail exchanges with **Simson Garfinkel** (note that I have featured a correct spelling of Simson's name this month—sorry for the error!). Simson's two published books are *Practical UNIX Security*, co-written in 1991 with Gene Spafford, and *NeXTSTEP Applications Programming*, written with Mike Mahoney. After six months of indecision, he has decided not to move back to California to go back to graduate school, and is instead at home in Cambridge working on two new books: one called *UNIX-HATERS*, the other an official history of artificial intelligence. Simson will have spent part of December and January in Japan, and plans to spend time in Austin, Texas, learning about SEMATECH this spring. Finally, Simson reports that **Andy Gerber** quit his job at ParcPlace and now works for USWest in Colorado.

**Joe Larocca** writes: "I am working for the cc:Mail division of Lotus in Mountain View, Calif., and just got back from a month-long business/pleasure trip to Italy, Switzerland, Spain, and Britain. Spain is cool because the beer is cheaper than the soda...."

Finally, from the Alumni/ae Office, we learn that **Bradley A. Feld** has been selected to be the president of the Young Entrepreneurs' Organization, Boston chapter. Bradley is the president of Feld Technologies, a custom software development and information technology consulting firm located in Boston that specializes in implementing business systems for small- to medium-sized firms. The company currently employs 18 people.

That's it! As you can see from some of the above items, if you send it, I'll print (most of) it... so write in!—**Jack Leifer**, secretary, 2703 Swisher Street #202 Austin, TX 78705; (512) 472-7507; fax: (512) 472-7546; e-mail: leifer@ccwf.cc.utexas.edu, or MIT1987@mitvma.mit.edu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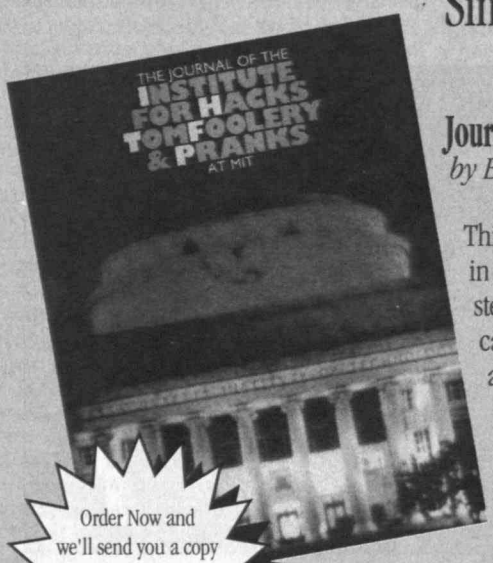


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*OCTOBER 2 IN IPSWICH... From left: Laura and Mark ('88) McDowell; Kirsten and Andy ('88) Keith; Karen (Krans, '88), Michelle, and Andy ('88) Cooprider; Matt ('88) and Laurie Kelley; Edward Nakamoto, '88; Jacob Wohlstadter, '90; Audrey (Chang) Nakamoto, '88; Barry ('88) and Lisa Berenberg; Kim and Paul ('88) Paternoster, and Art Nava, '88.*

# 88

Hello class of '88. This weekend was both MIT homecoming (we wooped Nichols 43 to 7!) and the Head of the Charles. For those of you who made it to Boston this weekend, let's hear some of those stories! Now on to the news...

**Debika Bhattacharya** married Deepak Kumar on October 12th. The newlyweds will reside in Philadelphia where Debika is employed at Bell Atlantic Network Services and Deepak is a professor at Bryn Mawr College. . . . On October 2nd, I attended the wedding of **Sheila Neville** and Bob Flory (SM '89) in beautiful Kennebunkport, Maine. President Bush was not at the wedding, but **Yakov Royter, Carla Kapikian, Nancy Perugini,** and **Joycelyn Valderamma Koehler** and many other MIT alums were present. Sheila and Bob honeymooned up the rocky coast of Maine. . . . **Kamala Sundaram** married Paul Grasso on May 29th in Milford, Conn. After a honeymoon to Italy they packed up and moved to Boulder, Colo., where Paul is in business school. Kamala started a new job at Valleylab, a manufacturer of surgical equipment. That is all the wedding announcements for now, but I am sure there is more out there, so pick up your mechanical pencil and let us in on your news.

**Brenan McCarragher** and his wife Hilary had a baby girl named Cera. They are now living in Australia where Brenan is teaching at the University of Canberra. Did you know that Canberra is the capitol of Australia? . . . **John Kohl** has started a new job at Atria Software in Natick and just bought a house in Arlington, Mass. John writes that his graduation announcement in this column led to a job interview which resulted in a position at his new company. John is an active alumnus volunteer with Alpha Phi Omega for which he oversees chapters in Maine, New Hampshire, and Vermont.

**Matt** and Laurie **Kelley** were married on October 2 in Ipswich, Mass., with the reception at the Manon on Turner Hill at the LaSallette Shrine. Matt is currently working in the Boston area for Rocket Software, a company that develops mainframe and client/server computer software, while Laurie is beginning a nursing program at Mass General. They are living in Waltham. Also attending were **Curt** and **Karen** (**Krans**) **Cooprider** from Federal Way, Wash., with their two girls: Nicole (2 years old) and Michelle (7 months old). Curt is working at the Boeing Co. and Karen has since left Boeing to take care of the girls at home. **Ed** and **Audrey** (**Chang**) **Nakamoto** visisted from Mountain View, Calif., where Ed works for Acuson and Audrey for LSI Logic.Kirsten and **Andy Keith** came from Trumball, Conn. Andy works for Sikorsky. Also at the wedding were Kim and **Paul Paternoster** from Fremont, Calif. Paul has recently changed jobs from DEC to Amdahl. Lisa and **Barry Berenberg** came from Fairfax, Va., where they both work at Orbital Sciences; they were married in February of '93. Laura and **Mark McDowell** also came from Virginia (Arlington). Mark is working for DSA, a small engineering consulting firm. **Art Nava** made the trip from Chicago, where he has just moved from his position at Bell Labs. Also attending was Jacob Wohlstadter, '90, who is working on a PhD at the graduate school of biology at Harvard.

**Hanson Cheah** writes us from a plane on his way home to Malaysia where he will start a new job as operations manager for Solectron Malaysia. . . . **Suresh Thirugnanam** has also returned to Malaysia to work for Motorola. Hanson previously resided in San Francisco, where he was employed by PRTM, a management consultant firm specializing in operations. Hanson frequently traveled to the Far East on business and was able to attend a MIT Club of Hong Kong meeting at which Dean Lester Thurow was the honored guest. Hanson writes that the prospects of the booming China trade has brought an amazing number of Chinese-speaking MIT alums to Hong Kong. Frankie Law, '85, president of the MIT Cub of Hong Kong hosted the meeting. Frankie is a manager for Citibank HK. **Ken Yeung** is working for McKinsey Hong Kong along with Mervin Chan, '90. Lulu Tsao, '86, is with a PR agency and Norman Chen, '86, is with Baxter. Tina Lee, '90, and Christine Ko, '89, are at Morgan Stanley. Jameo Yao, '89, is with Oracle in Beijing. Wan Lik Lee, '86, started his own software firm called Abaxis Systems. Christine Phoon is with the Dickson Group and Betty Woo, '83, is with the Bank of America. In the SF Bay Area, **Autoine Tirmerich** is working on finishing up a PhD at Stanford and **Craig Cohen** is at Stanford Business School.

Hanson also sends news about his PBE pledge brothers. **Moshin Lee** received a PhD from the MIT Mechanical Engineering depart-

*AND THAT SAME DAY IN KENNEBUNKPORT... From left: Bob Regan, SM '87; Mike Decker, '87; Yakov Royter, SM '88; Rich Roth, '86, PhD '92; Bob Flory, SM '89 (the groom); Sheila Neville Flory, '88 (the bride); Dan Kennedy, '87; Lowell Kim, '87; Andrew Singer, '90, SM '92; Cathy Suriano Singer, '88; Joycelyn Koehler, '88; Nancy Perugini, '88, SM '89; Dave Koehler, '87; Carla Kapikian, '88.*

ment and will marry Christina Yun (Wellesley '86) next August. **Mike Hon, Hoaug Do,** and **Raju Rishi** all work for AT&T in New Jersey. Hoaug and Raju are both happily married and Mike will tie the knot with Grace Lee next March. **Chris Thorman** is enjoying his work for a multimedia firm in San Francisco. **Karim Roshd** is writing a book in Paris. **Basil Horangic** is at Chicago Business School and is considering taking a break between an MBA and PhD.

I would like to thank all of you who wrote, especially Hanson Cheah who gets this month's award for reporting on the largest number of classmates. Please write and if possible include news on other classmates that you have kept in touch with. Keep sending that e-mail, it's quick, it's easy, and best of all you get to save 29 cents on the postage!—**Catherine Suriano Singer,** secretary, 131 Main Street #3, Andover, MA 01810, or e-mail: singer@mit.edu

## 89 5th Reunion

The reunion is rapidly approaching, and I hope people are thinking about coming. The committee has a lot of fun events planned, and it will be a good chance to see people and catch up. If anyone would like to ask any of the committee members about it, please feel free to call any of them. So far the committee is: **Hugo Ayala, Laura Brauer, Derek Chiou, Carissa Climaco, Nancy Gilman, Henry Houh, Ron Koo, Juli Lee** (chair), **Kenney Ng, Christine LeViness, Catherine Rocchio, Dave (Duis) Story,** and **Lori Tsuruda.** To obtain their (or any other numbers of grads), call the new toll-free MIT Alumni/ae Association number: 1-800-MIT-1865.

Everyone should have received a few reunion mailings by now, but if you haven't, it is possible that the Alumni/ae records have a different class affiliation listed (if you graduated in more or less than four years, or if you were in a co-op program). To fix that, just call the toll-free MIT AA number.

Submissions for the class calendar are still trickling in, so please send those pictures or video tape (either VHS or 8 mm). All submissions will be returned. We'll be publishing the school-year calendar, which will feature pictures of classmates, families, and other alumni/ae events, shortly after the reunion.

Here are this month's list of people to please write in: **Brian Brown, Andrew Brabson, Scott Hockett, Annabel Nickles,** and **Kee Wee.** What are y'all up to? If anyone knows about any of these people or anyone else, please write in!

In May, **Josephine Cheung** graduated with an ScD from MIT in materials science, and is now working at the construction specialties devision at W.R. Grace in Columbia, Md.

I received more information on **Bill Maney** and **Angeli Salgado**'s wedding. They were married last August in Monterey, in the San Carlos Cathedral, an historic Presidio mission that dates from the late 1700s. "The setting was just picturesque. The program was extremely personalized—I could feel their touch in every little detail from the passages they chose to the hymns and other music which their friends performed. In fact, Bill helped to write the processional music," writes **Ron Koo.**

In attendance were Ron, **Steve Payne,** Steve Brobst, G, **Steve Malinak, Thespina Hadjimichel, Lissa Sabia, Phil Kuhn, Joe Lichy,** and **Elizabeth Greyber, John Flight, Mark Coiley,** Grace Tseng, '90, Laura Scolnick, '90, Dan Mittleman, '88, **Ed Kim,** Nadine Regner, '91, Mike Turek, '88, Joe Landry, '88, Armando Fox, '90, Dave Berners, '90, **Illy King, Karen Tsuei,** Dave Maes, '87, Greg Carlin, G, Greg Schaffer, '64, and Mitch Liu, '92. Bill and Angeli took a two-week honeymoon in Greece.

On the weekend prior to the wedding, Bill held his bachelor party in Yosemite. Fourteen guys, including Joe Lichy, Joe Landry, Mike Turek, John Flight, Rodrigo, Dan Mittleman, Greg Carlin, and Ron, camped out in Tuolomne meadows, which is at 8,600 feet. They had a BBQ and drank, while Bill played his guitar and sang late into the night.

The next day, the group hiked to Cathedral Lakes, nestled in a bowl at 9,600 feet. "The lake was beautiful—clear blue and cold because it is fed by melting snow. Amazingly enough, the sides of the bowl of granite which contained the lake still had snow in several patches that got direct afternoon sun!" Ron threw a few snowballs that day.

Angeli held her bachelorette party in Calistoga the same weekend. She had a party of eight, with Laura and Thespina part of the party.

**Ira Scharf** writes in about **Tom Farkas** and Julie Primost's (Tufts '91) August wedding, held in Red Bank, N.J. They had a very nice ceremony outside on a beautiful sunny afternoon. Among the people in attendance were **Alex Rosen,** who was the best man, Ira and **Brian Luschwitz,** who were both groomsmen, **Dean Ebesu,** Ron Scharf, '92, and **Joe Lichy,** who came in from California. All shared the festivities with Tom and Julie for a weekend.

Ira is working in Cambridge for BBN, in their speech recognition group, and also hopes to finish a master's in computer science this year at MIT as well.

**Harry Hochheiser** writes to say hello. Harry just started a new job at Mass General Hospital, doing software development for the department of biomedical engineering. Harry has been enjoying his job so far.

**Barak Yedidia** recently become engaged to his dance partner, Valerie Lisiewicz (UCLA '88). Val and Barak have been competing in ballroom dance for the past two years and are currently Northern California Champions. Barak is working for GE in San Jose, training operators of power plants. Barak and Val plan a European honeymoon this May or June, and may even plan it so they can stop by our reunion on the way.

**Chris Maeda** is working on a PhD through CMU, although he is working in the CS department of the University of Washington. Chris was at MIT in October, presenting some of his research results at a talk at the Lab for Computer Science.

**Susan Streisand** is engaged to Steven Zweig, but haven't yet set a date. ("By the time it gets in print we'll probably be married—is the lag really that long?" Susan comments).

**Dan Garcia** won both a three-year NSF fellowship and an "Outstanding Graduate Student Instructor" award at Berkeley. Dan recently spent an evening with **Mark Itzkowitz** and his wife, Julie, and "had a blast." Dan sees a lot of ex-Baker people: Christina Schwarz, '90, Saskia Duyvesant, '91, and Adam Schwartz, '88. Dan has also been hucking plastic and trading puzzles with fellow grad student Hsin-Chao Phil Liao, '91. "Graduate life is treating me well," Dan comments.

Well, that's it for this month. Thanks again to everyone who wrote in, and I hope everyone is starting to plan those reunion trips! Please send news and photos! Thanks!—**Henry Houh,** secretary, 4 Ames St., Cambridge, MA 02142; phone: (617) 225-6680; fax: (617) 253-2673; e-mail: tripleh@mit.edu or hhh@mit.edu or henry_houh@mit.edu

# ClassNotes

## 90

**Alex Chen** received a master's in mechanical engineering from the University of Michigan in Ann Arbor. Now he is in Schenectady, N.Y., working at the GE Research and Development Center as a mechanical engineer in the Mechanical Systems Dynamics Program. . . . **Anne Law** is starting her first year at Northwestern's Kellogg Graduate School of Management after spending the past couple of years working in international marketing at Beiersdorf AG in Hamburg, Germany. Before classes began at Kellogg, Anne traveled to Hong Kong and China. In Hong Kong, Anne met up with **Koh-Ann Chu** and went out to take part in some karaoke!

**David Plass** recently got engaged to Sue Rodis of Woodbury, N.Y. They're planning an October 1994 wedding on Long Island. Sue is an orthodontist in West Islip, N.Y. She graduated from Tufts Dental School in 1988 and the Tufts Orthodontics Program in 1991. David, who is currently living in Manhattan, and Sue plan to settle down in Long Island after the wedding. . . . **Kimberly McNeil Keithline** is now a lieutenant in the U.S. Navy, working for Naval Reactors in Washington, D.C. She is responsible for manufacturing reactor cores for nuclear-powered submarines and surface ships. Kim is also very happily married to a navy submariner!

Looks like that's all the news I have this time. Let's keep those letters rolling in! Send news to—**Ning Peng,** secretary, 483 Beacon St., #41, Boston, MA 02115, or ning@athena.mit.edu.

## 91

**Lola Matysiak** writes , "Hi! Just wanted to give you some news...I just got engaged!" Rob Lohr, '89, proposed to Lola on a swan boat in the Boston Public Garden last August. "It was incredibly romantic and totally unexpected!" The couple plan a June 1995 wedding in New York. Rob is a management consultant at Price Waterhouse in Boston and Lola continues at Los Alamos National Labs in New Mexico.

**Paul Duncan** continues working for Oceaneering Space Systems in Houston. Jeff Meyers, '88, and Jud Hedgecock, '87, work with Paul in the Life Support and Cyrogenics Division, and **Art Schlou** and Rich Patten, '88, also work for the company, which just bought ILC Space System in Houston. He sends news that

# Puzzle

*Continued from Page MIT 47*

**Better Late Than Never**

**1992 OCT 2.** Eugene Sard believes that the improved solution suggested in the August/September 1993 issue is mistaken and that the original solution of 169 feet is correct. Sard writes: "The proposed improved solution seemingly ignores the fact that any 'shortest possible route' from 'A to B via the river' is the hypotenuse of a Pythagorean triple." Hence, Sard concludes, 92 and 133 cannot be solutions.

**Other Responders**

Responses have also been received from K. Bernstein, E. Biek G. Blondin, J. Brown, F. Carbin, J. Chandler, J. Cronin, M. Crystal, A. Dehnel, J. Dorsey, C. Estes, S. Feldman, P. Fermat, M. Fountain, D. Garcia, J. Grossman, A. Halberstadt, J. Harmse, W. Hart- ford, J. Hearn, R. Hedrick, R. Hedrick, R. Holt, J. Keilin, R. Laeach, D. Lang, P. Lao, P. LeBar, B. Levere, T. Lydon, J. Miller, S. Negahdaripour, J. Peltier, G. Perry, G. Raymond, K. Rosato, E. Sard, H. Sard, S. Shapiro, R. Short, N. Spencer, D. Wachsman, D. Wagger, C. Wampler N. Wickstrand, A. Wiegner, K. Wood, and R. Yaseen.

**Proposer's Solution To Speed Problem**

Ask to play 1/2 of your games as white and 1/2 as black. When white opponent n makes a move, play that move against black opponent n, then play black opponent n's move against white opponent n and so on. You will probably end up with the same number of wins as losses, but there is always the chance that white opponent n and black opponent n will both resign, giving you two wins with no counterbalancing losses.

**Cassandra Santos** works on propulsion for NASA's Mission Operations Division in Houston. I spoke with Paul while he was on a recent trip back to New England to attend the Design for Manufacturing and Assembly Workshop in Newport, R.I. He was recently voted into the League City, Tex., volunteer fire department after receiving substantial training in hoses, gear, ropework, arson, and the jaws of life. Although he's not exactly wishing for a League City blaze, Paul had not yet been called into action when I spoke with him in October. Paul enjoys bird-hunting near San Antonio and has also taken up shark fishing in the Gulf of Mexico. On a recent trip 60 miles off the coast, he spent 45 minutes reeling in an 8 ft., 130 lb. hammerhead shark, which he shared with friends and MIT alums at a teriyaki barbeque.

Congratulations to **Bennett Brown!** The Student Loan Marketing Association (Sallie Mae) recently awarded Bennett with a First-Year Teacher Award, which "recognizes outstanding performance by new elementary school teachers." Bennett, who was one of 100 teachers nationwide to receive the award, teaches 11th and 12th grade physics and chemistry at Du Sable High School in Chicago. According to "Sallie Mae," superintendents nominate one teacher from their district, who is selected on the basis of their instructional skills; interaction with students, faculty, and parents; and other distinguishing characteristics. A special aspect of the award is that a separate Teacher Tribute Award also honors the teacher who most influenced Bennett's decision to pursue an education career. Bennett chose James Jefson, who was Bennett's mathematics teacher in West Des Moines, Ia.

A picture of Princeton, N.J.'s "Palmer Square" arrives on **Nicola Bird**'s postcard, which she received for free and admits is a bit "cheesy." She continues to enjoy her work with Camp, Dresser, & McKee, an environmental consulting firm, and will attend Columbia University Law School this fall. Nicola visited Eva Regnier, '92, in Paris during June, and sends news that Eva is working on recycling projects for European companies. Nicola recently joined MIT's Educational Council and is interviewing prospective MIT students. She says, "It's a bizarre experience. I feel far too young to be interviewing anyone, and yet I feel so OLD next to these bright-eyed eager young teenagers."

Please send your news and even your cheesiest postcards to: **Andrew Strehle**, secretary, 566 Commonwealth Avenue, # 406, Boston, MA 02215, or call (617) 262-3495

## 92

Hey folks! Well, it looks like this winter season has slowed everyone down a bit. Unfortunately, I received only *one* letter this month. Thank you, **Matt "Skeeter" Hockett**, for being my saving grace. Matt is living in Minneapolis and is now well into his second year of medical school at the University of Minnesota. This fall he served as best man at the wedding of **Ruth Bunker** to **Dinesh Lathi**. Congratulations, Ruth and Dinesh. In attendance were **Jeff Jacobson, Mike Doane, Mike Pieck, CJ Whelan,** Bob Rockwell ('93), and Vijay Lathi ('94), the groom's brother. Matt welcomes anyone in Minnesota to look him up.

Matt also posed a good question—How does one go about changing their address with the Alumni/ae Association in order to stay in touch with MIT and other classmates? It's very simple really. You can call Alumni/ae Records directly at (617) 253-8270 and they will update your address, or you can call the Alumni/ae Association at (617) 253-8200. If you forget these phone numbers, call MIT's main information line, (617) 253-1000, and they will connect you. You can also mail a change-of-address postcard to MIT, Alumni/ae Records, 77 Massachusetts Ave., Bldg. 12-087, Cambridge, MA 02139. If you need to reach the Alumni/ae Association, it's Bldg. 10-110 for their main office. You can also send e-mail to John Blake at Jblake@MITVMC.MIT.edu. If you write to me, I can also update your address, though I am a much less efficient channel to go through.

I was fortunate enough to see **Joanne Gutierrez** when I was in Phoenix in October, via the Grand Canyon. Arizona is more than worth the trip if anyone has doubts as I did. While visiting with Joanne, I found out that **Matt Bloom** is grinding through medical school at Duke University in North Carolina. We spoke briefly on the phone. Matt says he likes school, but the hours are long and he misses fellow MITers. . . . Also heard news about **Jenny Rigney**. She is in graduate school at UMichigan. I met a couple of other friends of Jenny's in Phoenix through Joanne. As a matter of fact, we could have played "This is Your Life, Jen Rigney," as we had friends on hand representing her high school, college, and graduate school. . . . Lastly, I also stunned Karl Koschnitski ('93) in Phoenix by unexpectedly showing up at his door. He lives in the same apartment complex as Joanne.

Now comes the moment of truth, friends. I have thoroughly enjoyed reporting our class news for the past year, and as you all may or may not realize, I have at least another four years of reporting to do. At that time, we will have our first class reunion and you may or may not choose to reelect me. No, I am not plugging for reelection. I am asking you to continue to make my job as fun and successful as it has been for the past year by writing to me. You've all been great. But if one more month goes by without news from you, I will fall into a seriously depressed state and will have to start soliciting information. That won't be easy—we have at least 1,000 classmates scattered across the country as well as others. Please help me let everyone know what you're up to. Thanks.—**Leslie A. Barnett**, secretary, 42575 E. Hwy. 82, Aspen, CO 81611, (303) 920-1988 (home), (303) 925-1961 (work), or (303) 925-9389 (fax)

## 93

I hope that everyone enjoyed the holiday season with all the family and feasting. And back to work so soon! What ever happened to having January off? But back to what our classmates are up to.

The other day I got on the M2 bus from Vanderbilt Hall to Harvard Square, and there were **Karen Lee, Wyn Kao, Kenway Louie,** and **Yvonne Lin.** Karen and Wyn are both in the HST program. They claim they're lucky if they're out of classes by 5 p.m. (classes start at 9 a.m.). Kenway is attending Harvard Medical School and says he likes his classes. He reports that Otway is having a good time at Tufts Medical School, but it's a lot of work. Yvonne is also going to Harvard, but she is studying epidemiology at the School of Public Health. Also living in Vanderbilt Hall are **Oliver Chen** and **Kelly Sullivan.**

In other news, **Reshma Patel**, and our class president, is working in investment in New York City. . . . Our VP, **Ivana Markovic**, is working as a chemical processes engineer at Michelin down in South Carolina. . . . **Lisa Chow**, our treasurer, is now part of a think tank in Japan.

Fulfilling their Navy ROTC obligations are ensigns **Joseph K. Rivera, Juan C. Garcia, John G. Abbamondi, Andrew J. McFarland,** and **Frank J. Desimone.** . . . Finally, I would like to congratulate **Chad Gunnlaughsson** on his engagement to Rebecca Milam ('94).

Please feel free to tell us what you are up to! Address your letters to—**Mari Madsen**, secretary, 12-16 Ellery St., #405, Cambridge, MA 02138

# CourseNews

## I CIVIL AND ENVIRONMENTAL ENGINEERING

**Alonso E. Rhenals**, SM '74, CE '75, writes: "Since August 1992 I've been working as a senior analyst in the Decision Systems Group of Alphatech, Inc., an R&D company in Burlington, Mass., founded by some MIT professors. We are applying wavelets and neural networks to detect incipient failures in vibrating systems." . . . **W. Pat Donnelly**, SM '68, sends word from Bonita, Calif., that from 1968–88 he was in the U.S. Navy Civil Engineer Corps and from 1989 to the present, he has been VP forf engineering at Gosnell Development Corp. . . . **Nigel H.M. Wilson**, SM '67, PhD '70, writes: "I spent the 1992–93 academic year on sabbatical leave from MIT in London, splitting the year between London Transport and University College of London, conducting research on real-time operations control and passenger information systems for urban public transport systems." . . . **Diana Kirshen Pape**, SM '82, and **Mark Pape**, '78, SM '81, report: "Diana has become VP at ICF-Kaiser, Inc. Her primary work areas are in environmental engineering and policy support for EPA and DOE. Mark is director of environmental engineering for ECG, Inc., a two-year-old and growing company in Vienna, Va. Ben (6 years old) is gearing for MIT. Jen (5 years old), however, may not be an engineer."

**Paul N. Singarella**, SM '82, reports: "I am practicing environmental and water resources law with Pillsbury Madison & Sutro in Los Angeles. I graduated Order of the Coif from USC Law Center in 1991. My wife, Heather, and I had our first child, Nicholas, the week after I took the bar exam in 1991."

**R. Scott Phelan**, SM '90, PhD '93, writes: "I am now working for the California office of J. Muller International,, a bridge design firm based in Paris, France. My wife, Lauralee, and I now reside in San Diego, Calif." . . . From Fort Lewis, Wash., **Gregg Martin**, SM '88 (I, TPP), PhD '92, sends word: "I completed a nine-month tour in Central America in July 1993. I represented U.S. Southern Command in the area of U.S. strategy and policy in Latin America and the U.S. Naval War College's 'Global Game,' a major conference on U.S. global strategy held in Newport, R.I., last July. I then returned to U.S. Army's First Corps at Fort Lewis in August. Spent three weeks in South Korea participating in a major U.S.-Republic of Korea military exercise, and then moved into a new job in October, operations officer of an Army Combat Engineer battalion. Maggie and our three boys are doing great and enjoying life in the Pacific Northwest. In between all of my travels, we've had some great camping trips in the scenic part of the country."

**Richard J. Dauksys**, SM '70, sends word: "I was recently appointed director of polymers resource management for BASF Corp.'s Polymers Division (sales of approx. 1 billion)." . . . **John P. Dugan, Jr.**, SM '68, writes: "I manage the Glastonbury, Conn., office of Haley & Aldrich, Inc., geotechnical engineers and environmenal scientists. I am president of the Connecticut QBS Council, Inc., which promotes qualifications-based selection of design professionals to improve the quality of construction in Connecticut." . . . **Roger E. A. Arndt**, SM '62, PhD '67, professor of hydromechanics and chair of the Fluid Mechanics Program at the University of Minnesota at Minneapolis, has been named recipient of the Fluids Engineering Award from ASME. The award, established by the Fluids Division in 1968, is given for contributions to the engineering profession, particularly to fluids engineering through research, practice, or teaching. Arndt was cited for his "exceptional contributions to fluid mechanics, especially cavitation, jet noise, and hydraulic machinery; and for outstanding achievements in education in fluids engineering." Arndt continues guiding graduate students, but recently he retired from the university's St. Anthony Falls Hydraulic Laboratory where he served for 16 years as director.

*Roger Arndt*

*Alumni/ae may send info for Course News to* **mitalum@mitvmc.mit.edu**

## II MECHANICAL ENGINEERING

**Boris Rubinisky**, PhD '81, professor at the University of California at Berkeley, writes: "I was elected president of the American College of Cryosurgery. My collaborator, Gary Onik, and I revitalized this field by introducing new imaging technologies, and were essential in the resurgence of interest in the field of cryosurgery." . . . **Mat Waltrip**, SM '89 (II, XXII), reports: "I have left the Navy under the Voluntary Separation Incentive Program. Before leaving, I managed to complete the USS *Salt Lake City* (SSN 716) project nuclear work package $750,000 under budget We were also able to reduce occupational radiation exposure by about 40 percent. I was awarded the Navy Commendation Medal for my efforts. My wife and I now live in Pleasanton, Calif. I have taken a project management position in San Jose with Pacific Nuclear Fuel Services Group. We help nuclear utilities store their spent fuel with our patented NUHOMS dry modular storage technology." . . . From Newbury, Mass., **Bertram S. Noyes, Jr.**, SM '67, ME '69, writes: "I am working as a senior engineer at GE Aircraft Engines in Lynn, Mass., on fuel controls and accessories for jet engines." . . . **Kenneth Y. Kan**, SM '80, reports: "I have received a U.S. patent on tape head design on computer tape drives with two othe coworkers at DEC in Shrewsbury. The design allows the read/write functions for tapes with various thicknesses."

**Katherine C. Norris**, SM '67, writes to tell us that she is serving as scholarship committee chair for the Society of Women Engineers. . . . **Tom Taylor**, SM '91 (II, XV), and Julia Putnam, '89, SM '91 (III, XV), were married in April 1993. Julia is manager for emerging procedures at Ethicon Endo-Surgery Co., Johnson & Johnson. Tom is a manufacturing planner for the Delco Chassis Division at General Motors. . . . Word from **Nathan M. Stelman**, SM '88, in Foster City, Calif: "After leaving MIT, I spent five years with an automation systems integration company, providing robotic and machine vision systems for manufacturing applications ranging from pharmaceuticals to aerospace. I am now working in the same field as an independent consultant. The really

| DEGREE CODES | | | | | |
|---|---|---|---|---|---|
| AE | Aeronautical Engineer | ENE | Environmental Engineer | MPH | Master in Public Health |
| BE | Building Engineer | MAA | Master in Architecture Advanced Studies | MTE | Metallurgical Engineer |
| CE | Civil Engineer | MAE | Materials Engineer | NA | Naval Architect |
| CHE | Chemical Engineer | MAR | Master in Architecture | NE | Naval Engineer |
| CSE | Computer Science Engineer | MCP | Master in City Planning | NUE | Nuclear Engineer |
| DPH | Doctor of Public Health | ME | Mechanical Engineer | OCE | Ocean Engineer |
| EAA | Aeronautical & Astronautical Engineer | MET | Meteorologist | PhD | Doctor in Philosophy |
| EE | Electrical Engineer | MIE | Mineral Engineer | ScD | Doctor of Science |
| EGD | Doctor of Engineering | MME | Marine Mechanical Engineer | SE | Sanitary Engineer |
| | | MNG | Master in Engineering | SM | Master of Science |

big news this year, though, is my marriage to Cynthia Moss on June 20, 1993." . . . **Richard E. Von Turkovich**, SM '82, reports: "I am now a VP at Design Continuum in Boston, a strategic design consulting firm specializing in product development and corporate design strategy." . . . **Bradley M. Starobin**, SM '90, has been named a senior consultant and **David L. Bowen**, SM '83, ME '86, a corporate consultant at RH Lyon Corp. in Cambridge. Bowen was a principal scientist at the firm prior to holding this position.

**Mark Anderson**, SM '86, joined the Advanced Systems Group at Aerodyne Research, Inc., in Billerica, Mass., as a senior systems engineer. According to a company news release, his contributions will include "computational fluid dynamics analyses of aircraft exhaust systems, helicopter IR suppressors, and vortex wakes of aircraft. He will also be involved in combustor, nozzle, and exhaust plume modeling; radiative/convective heat transfer analyses in propulsion systems and suppressors; advanced combustion diagnostics; and field test definition, data analysis; and model validation." Prior to joining Aerodyne, Anderson worked at the Rocketdyne Division of Rockwell International Corp. in Canoga Park, Calif. . . . **William D. Gilbert**, SM '35, professor emeritus and former department head of mechanical engineering at Queen's University in Kingston, Ontario, was given an honorary doctor of science degree from Queen's. Gilbert served for six years during WWII in the Royal Canadian Corps of Electrical and Mechanical Engineers, achieving the rank of major throughout the Italian campaign. On returning to Canada, he joined Queen's faculty of applied science, where generations of students have known him as "Thermo Bill." He was the first winner of the Queen's alumni award for excellence in teaching. Gilbert's academic research, which had application in the design of heavy-water-moderated nuclear power generation, won him the Angus Medal of the Engineering Institute of Canada.

**Nam P. Suh**, '59, SM '61, Course II department head and the Ralph E. and Eloise F. Cross Professor of Manufacturing at MIT, has received the William T. Ennor Manufacturing Award of ASME. Established in 1990 by the ASME Production Engineering Division and the Alcoa Co., the award recognizes contributions to an innovative manufacturing technology, that have resulted in substantial economic or societal benefits. Suh was cited for "developing innovative manufacturing technologies for metals and polymers, in the science of tribology and design theory, and in public service to the manufacturing research community." Suh, who has been on the MIT faculty since 1970, is the founding director of the MIT Laboratory for Manufacturing and Productivity. He was also founder and director of the MIT-Industry Polymer Processing Program, and head of the mechanics and material division of the Mechanical Engineering Department. Between 1984–88, Suh took a leave of absence from MIT to accept a presidential appointment as the assistant director for engineering of the NSF.

**Gorken Melikian**, SM '57, of Somers, Conn., died on October 11, 1993. Melikian, a 36-year engineer for United Technologies, was manager of environmental systems and technologies, and headed the development of new concepts and systems in refrigeration at the time of his death. Melikian was active in fundraising for his Armenian church.

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## III MATERIALS SCIENCE AND ENGINEERING

**Tony Marquez**, SM '68, writes: "I have returned to school at the University of Texas at El Paso to obtain a PhD in materials science and engineering, after practicing dentistry for 20 years in El Paso. I have a junior associate who is buying into my practice and will eventually assume full control. I plan to teach at UTEP after obtaining my PhD and practice dentistry on a part-time basis. My dissertation for the PhD will focus on in vivo studies of dental materials." . . . From Philadephia, **Samuel K. Nash**, SM '48, ScD '51, reports: "I delivered the William H. Eisenman lecture (1993) to the Liberty Bell Chapter of ASM International. I was also awarded the Stanley J. Gwiazda Professorship for 1993 from Drexel University." . . . **John R. Mihalisin**, ScD '53, sends word from North Caldwell, N.J. "I am now retired but I do have my own consulting business." . . . Word from **John E. Niesse**, SM '56, ScD '58, in Manchester, Mo: "After Monsanto made an incentive offer which could not be refused, I 'retired' in January 1991. I entered the growing field of consultants. My specialties—corrosion and materials engineering with special emphasis on plastics and FRP." . . . From Lexington, Mass., **Charles P. Ashdown**, PhD '84, writes: "I am VP for technology at Ultrafine Powder Technology in Woonsocket, R.I., a manufacturer of specialty, ultrafine metal powders. I married Lore E. Kantrowitz on June 27, 1993, at the Codman House in Lincoln, Mass."

**Roger N. Wright**, '65, ScD '69, professor of materials engineering at Rensselaer Polytechnic Institute in Troy, N.Y., has been elected to the College of Fellows of the Society of Manufacturing Engineers. He is director of the Rensselaer High-Temperature Technology Program and co-director of the new Rensselaer Aluminum Processing Program. . . . **Régis M. Pelloux**, SM '56, ScD '58, Course III professor, has been made a Membre d'Honneur of the Société Française de Métallurgie et de Matériauz in recognition of his work on fatigue and failure analysis. This award was presented in Paris during the fall meeting of the French Society for Metals with many of his former French students in attendance. . . . **Nancy M. Huelsmann**, '82, has received the Distinguished New Engineer Award during the 1993 Society for Women Engineers (SWE) National Convention held last June. This award, established in 1978, is presented annually to honor women engineers who have been actively engaged in the Society and the engineering profession, who have demonstrated outstanding performance in both engineering and leadership, and who have no more than 10 years of cumulative engineering experience. "As a materials engineer for Hewlett-Packard Co., Huelsmann has held increasingly important positions in areas ranging from quality assurance to components engineering to managing technical and business relationships with key suppliers," states an SWE news release. Huelsmann recently accepted a six-month leadership position in materials procurement in Barcelona, Spain. She will be teamed with five other Hewlett-Packard women to start their Technical Women's Conference program.

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## IV ARCHITECTURE

From Washington, D.C., **John K. Bullard**, MAR '74, MCP '74, writes: "In August, I was appointed by President Clinton to serve as director of Sustainable Development and Intergovernmental Affairs with NOAA in the Department of Commerce. After working in New Bedford as mayor, historic preservationist, and fishing industry representative, I have moved to Washington. I would like to hear from people with an interest in sustainable development. My number at work is 202-482-3384." . . . **Allan Anderson**, MAR '60, writes: "In partnership since 1972 with my wife, Barbara, I have a medium-size architectural firm based in Rye, N.Y., specializing in institutional architecture. We have won 12 design awards for our projects, such as the Eugenio Maria de Hostos Microsociety School, the Rye Middle School, and the Milton School. We are currently doing projects in Vermont, Connecticut, and New York. I am the New York State coordinator for the 'Learning by Design' program of the AIA and am on the editorial board of the Council of Educational Facility Planners International. Two grandchildren are the apples of my eye. Another one is on the way." . . . **David Morris**, MAR '71, writes: "I had a one-man show of my kinetic water sculpture at the Laura Russo Gallery in Portland, Ore., last August and September. Water forms against bronze forms six to nine feet high."

**Brian C. O'Neill**, MAR '82, reports from Marietta, Ga.: "I was appointed project manager of architecture for Fulton County, Georgia, in February of 1993. I was previously with the City of Duluth, Georgia, as director of planning and development. I'm currently attending Georgia State University in pursuit of an MBA degree." . . . Lewis & Malm Architecture of Bucksport, Maine, co-owned by **Don Lewis**, MAR '73, was recognized in September 1993 by the Maine Health Care Association as the foremost designer and innovator of facilities design of nursing care, Alzheimer's, and assisted living for the elderly. . . . From Weehawken, N.J., **Bharat Gami**, MAA '79, reports: "My consulting firm, Gami and Associates, Architects, is gaining reputation through its work on the modernization of housing in various communities. I also won first prize from the National Institute for Architectural Education for my essay entitled 'A Community at a Time.'" . . . **Paul Pettigrew**, MAR '88, is a registered architect living/working in Chicago for Pappageorge Haymes, Ltd. . . . From Birmingham, Mich., **Robert L. Ziegelman**, MAR '59, wrote on October 8: "I am getting married to Judy Norwick in Laguna Nigal, Calif., on October 16, 1993, with a honeymoon in Bali. I just received a commission to design a $150,000 television studio and offices in Istanbul, Turkey."

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**Muhammad Abdus-Sabur,** MAR '78, writes: "I was the independent video producer of 'It's Intuitively Obvious,' an MIT-sponsored video highlighting student life at MIT from a minority student perspective." . . . From Cambridge, **Steve Imrich,** MAR '80, reports: "Last October, my family and I made a trip to Washington, D.C., to receive an honor award for 'Excellence on the Waterfront' for the Tennessee Aquarium Project for which I was project architect. The award was granted by the Waterfront Center, which held a juried competition. I'm currently working on an airport enhancement and aviation exhibit project at the Baltimore Washington International Airport." . . . **Thomas H. Hartshorne,** MAR '83, sends word: "I manage real estate that I designed and built in Brooklyn from 1984–91. I'm also taking some courses in biology—cell and genetics—at NYU. I play soccer with the Polish Club in the Cosmopolitan League." . . . **Joseph C. Schidlowski,** MAR '67, is a professor of architecture at Kent State University in Kent, Ohio. . . . **Terence S. Meehan,** MAR '83, is managing partner at M.J. Meehan & Co. in New York City. Meehan writes that he had the pleasure of designing the office and that the resulting "brokerage" office is a reflection of his MIT education.

The Association of Alumni and Alumnae has been notified that **Richard B. Morrill,** MAR '60, of Minneapolis, Minn., died on May 1, 1991. No further information was provided.

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## V CHEMISTRY

**Drew B. Burns,** SM '86, writes: "I was recently named head of the Science Department at The Pingry School in Martinsville, N.J." . . . **Arnold M. Schwartz,** PhD '74, sends word: "I have been promoted to full professor in the Department of Pathology at George Washington University's School of Medicine. I was also elected vice-chair of the faculty senate." . . . **Nancy Elise Gabriel,** PhD '86, writes: "I am married to Ichiro Sugioka, SM '85 (XVI). Our son, Kohji G. Sugioka, was born May 8, 1993." . . . **Chi-Huey Wong,** PhD '82, the Ernest Hahn Professor of Chemistry at The Scripps Research Institute, has been selected as the 1994 recipient of the International Carbohydrate Award in Honor of Roy Whistler, given by the International Union of Pure and Applied Chemistry. The award will be presented at the XVIIth International Carbohydrate Symposium in Ottawa this July. Wong specializes in the production and use of natural or modified enzymes for organic synthesis. This emphasis has important implications for efforts related to the creation of rationally designed drugs. A Scripp's news release states: "The $10,000 award recognizes Wong's work in developing strategies, techniques, and molecular designs based on enzymatic or combined chemical-enzymatic reactions that bring a new and refreshing dimension to carbohydrate chemistry and biochemistry. Both academic and industrial laboratories have recognized the practical aspects of his work and major applications are now being implemented."

*Chi-Huey Wong*

**Maryalice Conley Moore,** PhD '43, of Brewster, Mass., died on September 1, 1993. Moore worked for E.I. DuPont de Nemours in Newport, Del., for eight years in R&D. In 1955, she began teaching at Stonehill College in Easton as a chemistry professor and remained there until her retirement in 1981. She was past chair of the Chemistry Department at Stonehill, past officer and member of both the Simmons College and MIT Clubs of Cape Cod, and a member and officer of the New England Association of Chemistry Teachers and the new England Section of the American Chemistry Society.

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## VI ELECTRICAL ENGINEERING AND COMPUTER SCIENCE

**Robert A. Piankian,** SM '72, sends word from Brighton, Mass.: "I recently toured Europe with my wife, **Esther J. Horwich,** '77. The 'If It's Thursday, It Must Be Belgium' bus tour was tiring but exhilarating as it made the history books come alive. I'm providing managment and engineering expertise to start-ups in my consulting business. Four years ago, I started learning my first musical instrument (trombone), and added the piano three years later. I'm writing a book about learning a musical instrument as an adult and would love to hear about your musical experiences (rap@world.std.com)." . . . From Falls Church, Va., **Louis Blair,** SM '62, EE '63, reports: "I am executive secretary of the Harry Truman Scholarship Foundation, a federal agency that gives grants for graduate study to college students desiring careers in public service. Nine MIT students have won Truman Scholarships in the last 16 years. I was just elected as a Fellow of the National Academy of Public Administration." . . . **Valerie A. Lyons,** SM '80, (formerly Valerie C. Coel), writes: "I married W. Gregory Lyons, a staff member at Lincoln Lab, in May 1993. I'm currently the software support manager at Oberon Software in Cambridge. We reside in Concord, Mass., and enjoy being in the country setting while immersed in history."

**Walter C. Hamscher,** SM '83, PhD '88, reports: "I am a senior research scientist at the Price Waterhouse Technology Centre in Menlo Park, Calif. My research involves the use of artificial intelligence in audit and other tasks." . . . **Raymond W. Kinsley, Jr.,** EE '68, reports: "I'm relearning linear and switching regulator power supply design and troubleshooting." . . . From Columbus, Ohio, **Feng Zhao,** SM '88, PhD '92, sends word: "I joined the computer science faculty at Ohio State University in the fall of 1992 as an assistant professor." . . . **Walter T. White,** SM '39, ScD '41, reports: "Margaret Ann and I are now living at Tryon Estates in Columbus, N.C., an Adult Community Total Services in beautiful western North Carolina." . . . From McLean, Va., Captain **Steven N. Anastasion,** SM '48, writes: "I was named an honorary member of the Hungarian Academy of Engineering in 1991 and an honorary member of the National Academy of Engineering of Brazil in 1993." . . . **Nelson Chu,** SM '90, reports: "Last fall, I enrolled into the MBA program at the Harvard Business School." . . . **Robert Spinrad,** PhD '63, sends news from Palo Alto, Calif.: "I have been elected a member of the National Academy of Engineering. I am VP for technology analysis and development at Xerox."

**James S. Meditch,** SM '57, professor of electrical engineering at the University of Washington, writes: "My sabbatical leave during 1992–93, which kept me 'hopping,' was most rewarding both professionally and personally. From August 19 through October 1992, I held the TEPCO Chair of Electrical Engineering at the University of Tokyo where I conducted research and presented seminars on high-speed, integrated services, telecommunication network architectures, and protocols. I also visited the research laboratories of Hitachi, NEC, and Matsushita. Then, it was on to Stanford University where I was affiliated with the Department of Electrical Engineering and the Compter Systems Laboratory for the next four months. Over that period, I completed two journal papers, co-wrote another with a colleague at the Computer Systems Laboratory, and presented two lectures in a senior elective course. Finally, it was the ETH in Zurich for March 1 through June 15 as a visiting professor in the Computer Engineering and Networks Laboratory. My efforts there included R&D work on a multimedia workstation for desktop video conferencing, and on traffic control and network management for high-speed networks." . . . **Daniel Huttenlocher,** SM '84, PhD '88, has been named the 1993 New York CASE Professor of the Year.

**Lotfi A. Zadeh,** SM '46, professor emeritus in the Computer Science Division at the University of California at Berkeley, has been given the Rufus Oldenburger Medal of ASME. The medal, established in 1968, is given for outstanding achievements in the field of automatic control and is named for a leader in the field. Zadeh was cited for his "seminal contributions in system theory, decision analysis, and theory of fuzzy sets and its applications to artificial intelligence, linguistics, logic, expert systems, and neural networks." Zadeh began his teaching career as an instructor in 1946 at Columbia University. In 1957 he became a professor in the Electrical Engineering Department. In 1959 he moved to the University of California. He was appointed chair of the university's Department of Electrical Engineering in 1963, a position he held until 1968. During his tenure, he played a key role in establishing computer science as a major activity in electrical engineering and was instrumental in changing the name of the department to the Department of Electrical Engineering and Computer Science. . . . **Beth Levin,** '76, SM '79, PhD '83, has recently published *English Verb Classes and Alternations: A Preliminary Investigation* (University of Chicago Press,

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1993). In this reference work, Levin classifies over 3,000 English verbs according to shared meaning and behavior. According to the book's jacket, Levin "starts with the hypothesis that a verb's meaning influences its syntactic behavior and develops it into a powerful tool for studying the English verb lexicon. She shows how identifying verbs with similar syntactic behavior provides an effective means of distinguishing semantically coherent verb classes, and isolates these classes by examining verb behavior with respect to a wide range of syntactic alternations that reflect verb meaning." Levin is associate professor of linguistics at Northwestern University.

The long-awaited *The New Hacker's Dictionary, Second Edition* (MIT Press, 1993) has hit the stores. This edition was compiled by **Eric S. Raymond**, SM '77, PhD '80, an independent software developer and writer. "This edition of the hacker's own phenomenally successful lexicon includes more than 200 new entries and updates or revises 175 more. Historically and etymologically richer than its predecessor, it supplies additional background on existing entries and clarifies the murky origins of several important jargon terms (overturning a few long-standing folk etymologies) while still retaining its high giggle value," states the book's jacket. William Safire of the *New York Times Magazine*, calls the book "a sprightly lexicon."

**Paul R. Getchell**, '59, of Burlington, Mass., died on July 18, 1993. He was a retired professional registered engineer for the New England Telephone Co. At age 18, Getchell joined the U.S. Army Signal Corps where he served as an instructor in telephone installation and repair in New Jersey. He then joined the Massachusetts National Guard, serving three years as an aircraft radio mechanic. Later he enlisted in the Air Force Reserve and was commissioned a second lieutenant. Four days after Getchell joined New England Telephone in 1953, he participated in a dinner for his father who was honored for serving with that same company for 40 years. He was active with the Boy Scouts of America. . . . **Raymond H. Bennighof**, SM '52, of Phoenix, Md., died on December 31, 1992, of metastatic ampullary carcinoma. . . . The Assocation of Alumni and Alumnae has been notified that **Manuel Cerrillo Valdivia**, PhD '47, of Bosque De Echegaray, Mexico, died on August 16, 1987. No further information was provided.

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### VI-A INTERNSHIP PROGRAM

In the January Course VI-A column, I covered the administrative team put in place to run VI-A until a new director is appointed. I'm pleased to report that the team is functioning well and is overseeing the integration of VI-A with the Department's new five-year MNG Program. Predictably, this ensuing year will see a number of questions raised concerning VI-A and the new curriculum and I'll try to report on those of interest to alumni/ae as they're resolved.

This fall I've met a number of alums on campus for various activities. RLE's 1993 Computer-Aided Design Review was held at MIT October 7. Attending was Professor **Wayne P. Burleson**, '83, SM '83, with the Electrical & Computer Engineering Department at the University of Massachusetts at Amherst, and **Mark W. Reichelt**, '87, SM '87, PhD '93, of Mathworks, Inc., of Natick, Mass. I had a nice chat with both of them.

At the MIT Career Services Office one day, I met **David L. Lyon**, '69, SM '70, PhD '72, who is president of Pacific Communication Sciences, Inc., of San Diego, who told me that VI-A was a highlight of his experience at MIT. (He worked at Bell Labs, Inc., on VI-A).

That same day I also chanced to meet **Frank M. Sauk**, '74, SM '77, who was interviewing for Schlumberger in Burlington, Vt. Also here for Schlumberger was **Burnell (Burnie) G. West**, '60, who coordinates VI-A for us at Schlumberger's ATE Division in San Jose, Calif., and **Guy Vachon**, '80, SM '81, EE '83, PhD '84, coordinator for assignments at their Austin, Tex., facility, both of whom had lengthy conversations with Professor **J. Francis Reintjes** and me.

**David Chiang**, '84, SM '85, is with a fast-growing firm called Xilinx Co. located in San Jose, Calif. His firm expressed an interest in joining the VI-A Program and so Dave, while east to represent Xilinx at a Society of Women Engineers Career Fair on campus, arranged to meet with us to learn the procedures for joining the Program and to acquaint us with their line of work.

While passing through Boston, **Eric D. Black**, '77, SM '81, stopped by for a visit. Eric and his wife live in La Honda, Calif., and he's doing computer consulting under the name of Mirador Computing Systems with some business in Denmark. He is also a country dance caller on the side.

**Chester M. Day, Jr.**, '57, SM '58, a long-time VI-A coordinator at Bellcore in New Jersey, called one afternoon to learn more about the current VI-A management arrangements. We also conversed about the changes in the Bell System inasmuch as I worked at Bell Labs back in the '50s, prior to coming to MIT, and had continued a close association during my years as VI-A director.

A letter from **Andrew E. Moysenko**, '72, SM '74, informs me that he has returned to Lockheed/Sanders (formerly Sanders Associates). We had had lunch, some time ago, to talk over employment matters. Andy and his wife live in Lowell, Mass.

Lastly, **Richard S. Grinnell**, '93, SM '93, a VI-A advisee of mine, was back on campus interviewing for PictureTel of Danvers, Mass., where he is currently on the engineering staff.—John A. Tucker, director (emeritus), VI-A Internship Program, MIT, Room 38-473, Cambridge, MA, 02139-4307.

## VII BIOLOGY

**Hong Ma**, PhD '88, sends word: "1993 has been a very good year. The research in my lab at Cold Spring Harbor Laboratory has continued to yield interesting results, and I attended an unprecendented number of scientific meetings (4). During these meetings, I saw several old friends and colleagues, including **Lawrence Hobbie**, PhD '87. Lawrence and his wife had just had a son, Jacob, who adds another dimension to the already rich life that Lawrence leads. I was also able to see some of my classmates from back when I was a college

student in China. Seeing them after 10 years brought back a lot of memories and led to some reflections. One other thing that was very nice was that the Genetic Society of America featured me among several scientists from across the country in a booklet ('Solving the Puzzles') about genetics and it applications directed toward high school students. This was very encouraging for a young guy like me. Then, just recently, the news came that the 1993 Nobel Prize for Medicine and Physiology was awarded to the discoverers of RNA splicing, **Phillip Sharp** and Richard Roberts. Since Phil is the current chair of the Department of Biology, and since Rich had been an assistant director at Cold Spring Harbor Lab, where I now work, I am doubly happy and proud for the recognition that these two scientists well deserve." . . . **Athena Andreadis**, PhD '84, sends word from Cambridge, Mass.: "I have been promoted to assistant professor in neurology at Brigham and Women's/Harvard Medical School, where I am examining the regulation of neuron-specific genes."

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## VIII PHYSICS

**Hans Mark**, PhD '54, writes: "I left office as chancellor of the University of Texas system on September 1, 1992, after serving eight years. During my term in office, the budget of the university doubled and two new campuses were added to the system, raising the number from 13 to 15. I also led the effort to persuade the Texas Legislature to pass the Intellectual Property Act of 1987, which has permitted Texas public universities to contribute substantially to economic development." . . . From Fort Wayne, Ind., **George R. Donner**, PhD '69, reports: "I am trust officer for investments at Fort Wayne National Bank. In September 1993, I received the Chartered Financial Analyst designation." . . . **Sol Aisenberg**, PhD '57, sends word: "I am active in effective technology transfer including enhancing or bypassing of patents. I assist companies to convert from defense business to commercial business." . . . **John E. Mekota**, '50, writes: "I am still an occasional visiting lecturer at Doane College. It's fun to donate services as well as cash to one's alma mater(s)— I recommend it to others! . . . **Eugene F. Young**, PhD '66, has been named senior scientist at Perkin-Elmer Corp. in Norwalk, Conn. . . . **Lynn T. Cominsky**, PhD '81, has been named as the 1993 California CASE Professor of the Year.

**George Sargent Janes**, PhD '53, of Lincoln, Mass., died on August 14, 1993. He was an authority in the field of plasma physics and laser technology, as well as an avid sailor, canoeist, and climber. Janes joined the Avco Everett Research Laboratory (currently Textron Defense Systems) in 1956. During his 31-year career at Avco he published numerous technical articles and held top secret clearances with the DOD and DOE. He held more than 22 patents with others pending. Janes' technical activities at Avco included laser technology applications for spectroscopy, submarine laser communications, laser damage effects, and optical jammers. His research in plasma physics, with applications to isotope separation, led him to coinvent an Atomic Vapor Laser Isotope Separation Process. This development later resulted in a joint venture between Avco and Exxon Corp. Since his retirement from Avco in 1987, Janes had been affiliated with the MIT Spectroscopy Lab, where he pursued medical applications for lasers in cardio-vascular treatment and diagnosis. In addition, he developed algorithms for optimizing the design of optical-fiber-based probes and catheters for medical applications. He was a fellow of the American Physical Society and served on the advisory committee to the MIT Laser Research Center.

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## X CHEMICAL ENGINEERING

**Peter C. Farrell**, SM '67, writes: "I am chair & CEO of ResCare, Ltd., a manufacturer of respiratory products based in Sydney, Australia. ResCare's primary focus is on the production of nasal CPAP flow generators and mask systems to treat obstructive sleep apnea, which affects about 5 percent of the population. ResCare started as an MBO from Baxter Health care in 1989; ResCare exports to 35 countries and has branch offices in San Diego and Oxford. . . . **Frank T. Gentile**, PhD '88, reports: "I am currently the manager of bioengineering at Cyto Therapeutics, Inc. (a start-up biotech company treating CNS diseases with encapsulated cells). I am the father of three boys (3 1/2, 2 1/2, and 3 months)." . . . **Mark Bennett**, PhD '90, writes from Huntsville, Va: "I am an environmental consultant with the Earth Technology Corp., specializing in regulatory requirements arising from the Clean Air Act and the Resource Conservation and Recovery Act." . . . **Peter Hirsch**, SM '79, reports from Los Angeles: "I am completing my fifth year as an account manager with the telecommunications company, ROLM. I manage sales to the HMO, Kaiser Permanente in Southern California. In 1992, I was ROLM's national sales leader. . . . **Edgar B. Gutoff**, SM '52, ScD '54, sends word from Brookline, Mass.: "I am consulting in the areas of coating (of continuous webs) and drying. I organized a two-day course on Technology of Thin Film Coatings; and a one-day course on Coating Defects given at the biennial International Coating Process Science and Technology Symposia at the AIChE Spring National Meetings. I am also an adjunct professor at Northeastern University." . . . **Leo Hieblinger**, '61, reports: "We are now in our 5th year in Hong Kong, and we will be here through 1997 when Hong Kong reverts to China. I still spend 3/4 of the year in China. I now have two joint ventures to watch over, one in Guangzhou (Guangdong Province) and Taiyuan (Shanxi Province). I have now been in every province and autonomous region in China, most of the time in real boondocks. The boy (my son) made it to U-Penn so we now see him even less then when he went to Middlesex. Last year he traveled throughout all Europe. So we are truly a family of cultural nomads. Greetings to all." . . . **William A. Klemm**, ScD '46, writes: "I officially retired May 1990 but am still teaching part-time at

# CourseNews

South Dakota School of Mines and Technology. . . . **Cynthia S. Atherton**, SM '85, sends word: "I completed all my work for a PhD in Atomospheric Sciences at U. C. Davis on October 22, 1993." . . . **Margaret N. Ingalls**, SM '83, reports: "I am starting work again after starting a family, consulting for a small firm. I have two boys: six and three). . . . **Mark Hymen, Jr.**, SM '39, writes from Cambridge: "I have been working with my friend, Professor Cornelius Hurlbut, on a new instrument that measures high refractive indices. It can measure RI's from 1.40 to 3.00. Its technology is based on Brewster's Law. Development is about complete." . . . **Edward Wilson Merrill**, ScD '42, who has been the Carbon P. Dubbs Professor of Chemical Engineering at MIT since 1974, has been named the recipient of the Charles M.A. Stine Award in Materials Engineering and Sciences given by the AIChE. The author of 226 technical publications, Merrill specializes in polymers and biomedical engineering and biomaterials. He joined the MIT faculty in 1950, and became full professor in 1964. Merrill also serves as a consultant in biomedical engineering to Harvard University Health Services. The award is presented annually to recognize "outstanding contributions by members of AIChE to scientific, technological, educational, or service areas of materials engineering and science," and is underwritten by E.I. duPont de Nemours and Co. It consists of a plaque and a $1,000 honorarium. . . . **Murray W. Rosenthal**, ScD '53, immediate past deputy director of the DOE's Oak Ridge National Lab, has been presented the Distinguished Career Award by the Fusion Power Associates board of directors. He was praised for his "distinguished career as a researcher, manager, administrator, and valued advisor to the nuclear community in general and to the fusion community in particular." According to a Martin Marietta press release, "The award was established in 1987 to recongize individuals who have made distinguished, lifelong contributions that directly or indirectly have benefitted fusion. The challenge of fusion is to reproduce on earth the basic energy process of the sun and to use it for the benefit of humankind." Rosenthal served as deputy director of ORNL from 1989–93. He served as a special assistant to the laboratory director until his retirement in January 1994. He joined ORNL in 1953. From 1974–89, he was associate laboratory director for Advanced Energy Systems. In his early career at ORNL, he conducted research in reactor heat transfer. In later years, he held key positions in the homogeneous reactor and pebble-bed reactor programs and was responsible for evaluation and long-range planning for reactor programs.

*Murray Rosenthal*

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**Raymond T. Shanstrom,** ScD '59, of Stamford, Conn., died on July 24, 1993. He was a nuclear physicist and president of Shanstrom Associates. After serving as an officer in the U.S. Navy, he entered the doctoral program at MIT.

*Alumni/ae may send info for Course News to* **mitalum@mitvmc.mit.edu**

## X-A PRACTICE SCHOOL

Course X—and with it the Practice School—is riding the crest of a wave. Undergraduate enrollment (sophomores, juniors, and seniors) now exceeds 300; in all, 126 sophomores, about two-thirds of them women, came into chemical engineering last fall. Graduate enrollment is bulging, too; applications are up, and last year half of the department's offers were accepted. The department now hosts 40 post-docs, compared with 2 in 1980.

These figures were the background provided by Professor **Robert A. Brown,** department head, for those attending the Practice School's 14th annual information conference late last fall. They're relevant because they explain the growing demand for admission to SCEP. Thirty students received degrees of Master of Science in Chemical Engineering Practice in 1992–93—essentially SCEP's annual capacity. Already all available Practice School places are assigned through the fall term of 1994–95, according to Professor **T. Alan Hatton,** director; enrollment is limited by the number of suitable problems available from the host companies and by funding for fellowships and faculty.

SCEP funding for 1992–93 came from four sources, said Hatton: host companies for fellowships to students at the stations (32 percent), sponsoring companies (10 percent) and endowment (27 percent) for fellowships to SCEP students while in Cambridge, and MIT general funds (31 percent) for faculty salaries and operating expenses. None of these can be stretched enough to cover increases in enrollment or establishing one or more new summer stations, which would be the option of choice. Despite the pressure, no one, said Hatton, proposes any change in SCEP's basic commitment: "on-site supervision provided by 2 resident MIT faculty working with 6 to 11 students at a time—the key to the program's success and quality."

Hatton reported successful operations at both of the school's stations, Midland, Mich. (Dow Chemical Co., with additional support from Dow Corning Corp.) and West Point, Pa. (Manufacturing Division of Merck & Co.). Both are enthusiastic about SCEP's contributions. Forty projects were tackled by the 26 students at the stations in 1992–93, Hatton said; they involved process improvement, simulation studies, advanced separation, and analysis of new processes and reaction engineering concepts. Many students especially valued the exposure to biotechnical projects at West Point.

In addition to celebrating the special relationships between MIT and the companies that host SCEP stations and underwrite fellowships, the annual information conference gives company representatives a chance to meet graduate students who have attended SCEP as well as students—both undergraduate and graduate—who expect to do so in the future. In all, some 300 company people, faculty, students, and guests were on hand for the dinner at the end of the day. Alumni/ae who represented host and sponsoring companies included **Thomas Keene,** '50, SM '52, du Pont; **Kirk Limbach,** PhD '89, Rohm & Haas research laboratories; **Mark Marinan,** '81, Dow; **Siegfried Mayr,** SM '67, ScD '70, research and engineering systems, Air Products & Chemicals, Inc.; **Reiner Musier,** SM '86, PhD '89, Rohm & Haas; and **Jay Sobel,** '61, SM '63, PhD '68, Exxon Research & Engineering. Other alumni present as special guests: MIT Professor **Charles Cooney,** SM '67, PhD '70; MIT Professor **J. David Litster,** PhD '65, VP for research; **Michael Mohr,** '53, manager of electronics engineering at Grumman; **William Rousseau,** SM '36, senior visiting lecturer emeritus at MIT; MIT Professor **Adel Sarofim,** SM '57, ScD '62; and MIT Professor **Jefferson Tester,** PhD '71, former SCEP director who is now director of the MIT Energy Laboratory.

Carlos Rosas, VP for science and technology at Merck, paid SCEP a high compliment as conference dinner speaker: "I can think of no more noble cause than joining educational and industrial experience." He takes special satisfaction in MIT's presence at West Point, he said. Life scientists necessarily operate in the absence of predictive tools, and one reason for bringing SCEP to Merck three years ago was "to expose life scientists to the power of rigorous engineering analysis." And as the students are discovering, Rosas said, biotechnology has special rewards—its products almost invariably bring "important therapeutic or nutritional benefits."

Two changes in the basic chemical engineering curriculum stem from discussions at the 1992 SCEP information conference. Beginning in the current spring term, a new course in systems engineering has been added to the requirements for attending SCEP. The idea, Brown told the conference, is to "give students tools to help them structure and solve complex problems—for example, product and process development and design, experimental and theoretical analysis of physico-chemical processes, and analysis of process operations." And beginning this spring there will be a two-day intensive course on statistics for all SCEP students, made possible in part by Air Products & Chemicals.

Winners for 1993 of SCEP's three major annual awards were announced at the conference dinner: the **Rosemary Wojtowicz** ('82) Fellowship Award for "kindness and concern for the well-being of others" to **I-Ming Hsing,** SM '93; the Jefferson W. Tester Prize for "enthusiasm and leadership" in SCEP to **Bruce Lilly,** SM '93; and the **J. Edward Vivian** (SM '39, ScD '45) Prize for "outstanding leadership and management of project work" to **Radha Nayak,** SM '93.

**Lori Anger,** SM '93, came from Placentia, Calif., for the information conference. After a lazy summer of "lying in the sun," Lori is now looking for a job, she explained to **Carol Phillips** of the SCEP office. Also from Carol: **Michael Kwan,** SM '93, tells her that **Matthew Tyler,** SM '92, and his wife, Judy, are the parents of a son; Matthew is a doctoral student at Caltech. . . . **Aaron Mbowa,** '90, SM '91, hopes to finish graduate work at Columbia next fall. He's working on reactor design in mineral engineering; e-mail address: AKM3@columbia.edu . . . **Mohammed**

**Benchekroun,** SM '93, is happily at work in Fall River, Mass., as a research engineer at Molten Metal Technology, Inc.

From his retirement home in Altadena, Calif., **George Keene,** SM '52, writes that he is "consulting for several optical and aerospace firms on the design of satellite imaging systems for agricultural remote sensing." George formerly worked for Eastman Kodak, and he celebrates his new-found freedom on weekends at a new log home at 6500' elevation in the Tehachapi Mountains, where he's remounting his 20" f/5 telescope. . . . **Ernest Ohsol,** ScD '39, is a founding officer of Unipure Corp., Crosby, Texas, specializing in eliminating pollution by recycling in the petroleum industry. . . . Gold Peak Industries, Ltd., Hong Kong, has announced the appointment of **Andrew Ng,** SM '73, to be chairman and CEO. Ng joined GPI in 1975 as a partner in its Battery Division, and the company says he is today recognized "as an accomplished industrialist in the international battery trade."

*Now comes the best—saved for last.*

With a little help from the SCEP office in Cambridge, **John Young,** SM '48, retired from Battelle and living in Pasco, Wash., has reconstructed his memories of *the* famous SNIPE HUNT (or at least one of them) at the Bangor Station. It's a story that everyone recommended but no one could tell me while we were researching *The Flagship.*

Now here it is, with a delightfully quixotic ending.

The tale is set at Chimney Pond in Baxter State Park, Maine, the base camp for the assault on Mount Katahdin, Maine's highest, that was an annual tradition throughout the Bangor Station's long history Someone noted during after-supper conversation following the backpack in from the roadhead that this was fine country for snipe hunting. Soon enough one of Group 4A47's members, **Allen Sugden,** SM '48, a foreign student from England, revealed his innocence, and he was promptly designated the "catcher."

Continue now in Young's words:

"A gunny sack was found for the 'catcher,' and most of the rest of the group volunteered as 'beaters.' The 'catcher' was stationed in a dry rocky streambed some 3' deep and 8' wide. It was pitch dark with no moon, a very good condition for this type of snipe hunting.

"The 'beaters' split into two groups, moved quietly downstream away from the streambed for about 100 yards, then circled back up the streambed while hollering and beating the bushes. No snipe appeared; they found the 'catcher' empty-handed.

"The 'beaters' then repeated their maneuver, going some 200 yards before beating their way back to the 'catcher.' Again, he had neither heard nor caught a snipe.

"Then the 'beaters,' expressing their frustration, pledged a third trip downstream, further from the 'catcher's' post. But this time they did only a small amount of beating at a great distance from the 'catcher' and then returned to the camp for a game of gin rummy. Forty-five minutes later, the 'catcher' not having returned, **Jack Pohlenz,** ScD '47, the station director, began to worry; either the 'catcher' didn't realize it was a scam or was lost in the woods.

"The 'beaters' found the 'catcher' still faithfully at his station waiting excitedly for the next snipe to arrive. He told them that shortly after the 'beaters' had departed on their third trip, a fairly large animal (a fox, or perhaps a raccoon?) had run up the creekbed at high speed, directly into the 'catcher's' sack. The impact bowled the 'catcher' off his feet, but he was able to secure the sack with the unknown animal inside. There followed a wrestling match in which the 'catcher' was somewhat bruised and scratched and at the end of which the animal escaped.

"When the 'beaters' arrived, the 'catcher' wanted only for them to go send down another snipe. It took considerable persuading to convince the 'catcher' that it was now too late—time to rest for the next day's long climb.

"As far as I know, no one ever told the 'catcher' that it was just a scam.

"But then, who got scammed?"

Young's information is that the 'beaters' included **Roger Bart,** '46, SM '48, ScD '50; **Rudolf Carl,** '47, SM '48; **Donald Levenson,** SM '48; **Gilbert Lewis,** '43, **John Mealy,** SM '51; **Robert Meny,** '44, SM '48; **Harry Ponisi,** SM '48; and **Henry Sandler,** '47, SM '48. If any of the above have more memories to contribute or wish to proclaim their innocence (or if others not named above wish to make confessions), please let me know (or write to John Young in care of the *Review,* at the address below).

And to all readers: your news is awaited by classmates; please write!—John Mattill, *Technology Review,* Room W59-200, MIT, Cambridge 02139.

## XI URBAN STUDIES AND PLANNING

**Beatrice E. Lewis,** PhD '85, writes: "I'm reducing activities in my consulting firm, Humanized Environments. For the past three years, I have focused on changing my husband's business from a personality business to a "product" business, which makes it saleable on his retirement. My marketing efforts have increased the business three-fold, without increasing overheads. I am now traveling more and have become seriously involved with quilting and am soon to teach English as a Second Language." . . . **Ira Haironson,** MCP '85, reports: "I am now planning bus routes in Brooklyn, where I grew up. 'You never leave Brooklyn, no matter how hard you try.'" . . . **Rochelle Bates Lee,** MCP '84, sends word: "On September 7th, I began working in a new position as program officer with the national non-profit organization, Local Initiatives Support Corp., located in Providence, R.I." . . . From Coral Gables, Fla., **Garrett Sloan,** SM '40, writes: "After some 37 years of public service, I retired on June 14, 1993. I have been employed by the Miami-Dade Water and Sewer Authority Department in the capacity of director since its creation in 1973." . . . Last July, **W. Henry Atkins,** SM '91, formed his own real estate company, The Atkins Group, based in Charlotte, N.C. . . . **Dan Bernstein,** MCP '86, sends word: "I am in my second year of doctoral studies at the Rockefeller College of SUNY Albany, focusing on applications of public policy in the field of system dynamics. My wife, Efrat, daughters (Dara, age 4, and Meiray, age 2), and I are enjoying the move to the capital district."

# CourseNews

**Philippe E. Annez,** MAR '71 (IV), PhD '81, reports: "I was for four and a half years the World Bank's regional representative in Bangkok covering Burma, Thailand, Lao P.D.R., Vietnam, and Cambodia. At the end of my term here I decided that 11 years with the World Bank was enough and since South East Asia is going to become the main centre of World growth, and since I love living in Thailand, I decided to stay there and start my own business. I have founded Griffon, Ltd., a computer software company producing customised products for corporate clients and government agencies. The beginning was very hard but now things start looking up." . . . From Washington, D.C., **John K. Bullard,** MAR '74 (IV), MCP '74, writes: "In August, I was appointed by President Clinton to serve as director of Sustainable Development and Intergovernmental Affairs with NOAA in the Department of Commerce. After working in New Bedford as mayor, historic preservationist, and fishing industry representative, I have moved to Washington. I would like to hear from people with an interest in sustainable development. My number at work is (202) 482-3384." . . . **Joseph Chow,** SM '81 (XV), MCP '81, and Selina Chow, SM '81 (XV), announce the arrival of Kathryn Lauren on September 13, 1993. Kathryn is sibling to Joanna (age 7) and Jason (age 5). The family lives in Brookline and Joseph is VP at State Street Bank & Trust . . . **Angela N. Murray,** SM '92, has been appointed director of the Builder Developer Division at Paul Semonin Realtors in Louisville, Ky. She has more than 15 years experience in the management and development of large-scale commercial and residential projects. Most recently she was with the Community Builders in Philadelphia as a real estate development consulatant.

**Carlos Eugenio Dominguez Vial,** PhD '81, of Arlington, Mass., died on August 26, 1993. Excerpts from an obituary that appeared in the *Arlington Advocate* follow: "As Chile's senior executive for Agricultural Foreign Trade, he served as representative and negotiator for Chile in developing agriculture and trade programs for the Andean region. In 1973, when the Allende Government was overthrown by a militry dictatorship, Dominguez was imprisioned, tortured, and later exiled. Through his writings, speaking engagements for Amnesty International and other groups, and by opening his home to fellow exiles, he soon became a leading figure in the the Chilean expatriate community. He also wrote articles in Spanish and English on urban and rural planning and social and economic development and was a consulttnt to the Massachusetts Department of Welfare and the Metropolitan Area Planning Council. He was district manager for the 1990 U.S. Census and a visiting lecturer at area colleges.He volunteered his time to the Arlington Fair Housing Committee and the Peace and Justice Commission of the Archdiocese of Boston.

**Nathan C. Burbank, Jr.,** ScD '55, of Tucson, Ariz., died on August 5, 1993. From 1957–63, he was the head of the department and a professor of Civil and Sanitary Engi-

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neering at Washington University in St. Louis. From 1963–77, he held the same position at the University of Hawaii. He also served as a sanitary engineer in the Departments of Health for Maine and Iowa. During WWII, he was a commissioned officer in the U.S. Public Health Service. Until recently, Burbank was teaching the inmates at the Arizona State Prision about water treatment so when they got out they would have a trade. . . . The Association of Alumni and Alumnae has been notified that Colonel **Eugenio Ocampo, Jr.**, '78, of Quezon City, Philippines, died in 1993. No further details were provided.

*Nathan Burbank*

*Alumni/ae may send info for Course News to* **mitalum@mitvmc.mit.edu**

## XII EARTH, ATMOSPHERIC, AND PLANETARY SCIENCES

From Vancouver, B.C., **J.E. Kania**, PhD '30, writes: "Although I am the oldest surviving member of my class, I still enjoy travel, playing my violin or viola, playing chess, reading, going to the theatre, etc. My first wife, Nan, died in 1987. We were married 59 years. Two years later I married an old family friend and my brother-in-law's youngest sister, a widow and my accompanist for 45 years. We celebrated her 80th birthday in Vienna last June, part of our three weeks travel. I am well, but getting old." . . . **Grant Buma**, SM '70, sends word from Salt Lake City: "I am president of the Utah Chapter of AIPG. I'm working on registration of geologists and doing private consulting on a variety of hazardous waste projects. We have a contract with the Colorado River Indian Tribes to set up a new water district on the Colorado River." . . . **Pierre-Yves F. Robin**, PhD '74, reports from Mississauga, Ontario: "I am still employed as a professor of geology at the University of Toronto. I am on research leave throughout 1993–94." . . . **Anne F. Sheehan**, PhD '91, writes: "Last September I started as assistant professor of geological sciences and as a fellow of the Cooperative Institute for Research in the Environmental Sciences Department at the University of Colorado at Boulder." . . . From Saco, Maine, **Horace Wood, Jr.**, '45, reports: "I would like to be in touch with members of Naval Officers in Aerological Engineering at MIT in 1943–44, or staff members under Professor Houghton (Brooks, Malone, Horowitz, Austin, etc.)."

MIT researchers made a splash at the American Astronomical Society's Division of Planetary Sciences (DPS) annual meeting, held last October in Boulder, Colo. Top billing at the meeting went to an icy body called P/Shoemaker-Levy 9, a comet which is on a collision course for Jupiter. .Course XII PhD candidate, **Joseph Harrington**, '88 (VIII), with his advisor, Professor **Timothy Dowling**, fellow graduate student **Ray LeBeau**, and UROP student **Kari Backes**, have developed a theoretical model of Jupiter's response to the impact. Their work was one of the few stories that was selected for notice by *Science* (*Science* 262, 505). The researchers are proposing to use the Hubble Space Telescope to look for the effects they predict. Another department member was highlighted in an article in *Science News*. The discovery by **Heidi B. Hammel**, '92, a Course XII principal research scientist, and Ray LeBeau, that the northern hemisphere of the planet Neptune has undergone a radical change in brightness, was featured in *Science News* (Vol. 144, No. 287). It was also announced at the Boulder meeting that Hammel was elected to the DPS committee for a three-year term. As such, she will be playing an active role in decision-making for the division, which currently serves over 880 planetary astronomers and scientists.

**Melvin Pollard**, '54, of Boston, died on August 12, 1993. In an obituary that appeared in the *Boston Globe*, Pollard was referred to as a "boy wonder" because he graduated from high school at 14 and from Harvard University at age 18, the youngest member of his undergraduate class. He interrupted his graduate studies of geophysics and archeology during WWII and became a naval combat pilot in the Pacific Theater. After the war, Pollard was an instructor of geophysics at MIT and taught mathematics at Boston University. He taught mathematics and science classes at Boston Lubavitz Yeshiva from 1962–64. He also taught at New Bedford High, Jamaica Plain High School, and Boston Technical School.

*Alumni/ae may send info for Course News to* **mitalum@mitvmc.mit.edu**

## XIII OCEAN ENGINEERING

**Henry J. Nardone**, NE '52, sends word from Westerly, R.I.: "The University of Rhode Island awarded me an honorary doctorate at their commencement on May 25, 1993. This is the second honorary doctorate awarded me. The previous one came from Rhode Island College in May 1991." . . . Captain **Robert J. Johnston**, SM '48, writes: "I was presented an award by the International Hydrofoil Society for superior achievement. The award cites my achievements in significantly advancing the development, application, and support of hydrofoil technology for national and international maritime interests. I live in Daytona Beach, Fla., and head a small consulting firm, Advanced Marine Systems Associates (AMSA). AMSA undertakes special projects related to high-speed waterborne transportation." . . . **Joseph Leo Coburn, Jr.**, SM '61, NE '61, reports: "I continue as marine operations manager at Woods Hole Oceanographic Institution. A great job with a great organization." . . . From Edmonds, Wash., **Henry J. Moravec**, SM '60, NE '60, writes: "I've just returned from a 40-day, 2,000 km bicycle trip that I led through Bavaria, Austria, and the Czech Republic. Our group of 11 retired professionals (engineers, lawyers, dentists) was successful in linking up the three cities of the old Hapsburg empire—Vienna, Budapest, and Prague—all by self-supported bicycles, ie. no sag wagon."

From Bellaire, Tex., **Richard Byrnes**, SM

'89 (XIII, TPP), sends word: "I lead the transportation consulting activities in Booz Allen & Hamilton's Houston office. I have been working for maritime and rail clients in the Gulf and Latin America, and my firm was recently selected to develop a master plan for the port of Houston. . . . **James H. Wicks, Jr.**, SM '87(XIII, XXII), writes: "I retired from the U.S. Navy and accepted a job as the West Tank Farm operations manager at Westinghouse Hanford Co. in Richland, Wash. . . . **Joseph A. Carnevale, Jr.**, SM '80, OCE '80, reports: "I was promoted to captain of the U.S. Navy in August 1992. I assumed command of the supervisor of shipbuilding in Pascagoula, Miss., in June 1993, after a tour as director for surface combatants in the office of the assistant secretary of the Navy (research, development, and acquistion)." . . . **David C. Hermann**, SM '91, writes: "I married Jennifer Locke, my girlfriend of seven years, on July 13, 1993, with many MIT friends in attendance. The year after graduating, I worked as an environmental engineer with the U.S. Army Corps of Engineers in Waltham, Mass. I am currently a foreign service officer with the U.S. State Department. I have a dual assignment with our embassy in Mexico City, and serve in both the Consular Section and the Science and Technology Section." Hermann hopes to become involved with the MIT Club of Mexico.

The Association of Alumni and Alumnae has been notified that **James McIntosh**, SM '44, of Monterey, Calif., died on May 9, 1993. No futher information was provided.

*Alumni/ae may send info for Course News to* **mitalum@mitvmc.mit.edu**

## XIV ECONOMICS

From San Francisco, **Richard Lyons**, PhD '87, writes to tell us that he recently moved from Columbia Business School to Berkeley Business School. . . . **David McClain**, PhD '74, reports: "I was dean ad interim of the College of Business Administration at the University of Hawaii from 1992–93. I continue as the Henry Walker Professor of Business and Finance, a position I have held since 1991." . . . Senator **A.J. MacEachen**, '53, sends word from Ottawa, Ontario: "I was awarded the Grand Cross of the order of Merit by the President of the Federal Republic of Germany in a ceremony held in Freiberg, Saxony on October 5, 1993. It was awarded 'in recognition of contributions in furtherance of international understanding.' The ceremony was presided over by Kurt Biedenkopf, the minister president of Saxony." . . . **John Shelton Reed**, '64, has recently published *Surveying the South: Studies in Regional Sociology* (University of Missouri Press, 1993). "Beginning with the roots of regional sociology, Reed examines threads of Southern continuity and change, including such issues as Southern sterotypes and the changing definition of the South. His fascinating history of the elusive but often-cited correlation between cotton prices and lynching offers a profound warning to students and professors alike: always verify your references. Reed offers several essays on what has been called 'the central theme' of Southern sociology—race relations. He demonstrates the success of the civil rights movement in the South and explores the ways in which Southern identity has become more regional than racial," states a University of Missouri press release. He is the author of many books, including *My Tears Spoiled My Aim and Other Reflections on Southern Culture* and *Whistling Dixie: Dispatches from the South*. Reed is the William Rand Kenan, Jr., Professor of Sociology, adjunct professor of American studies, and director of the Institute for Research in Social Science at the University of North Carolina at Chapel Hill.

The Association of Alumni and Alumnae has been notified that **Marian Krzyzaniak**, PhD '59, died on April 14, 1993. No further information was provided.

*Alumni/ae may send info for Course News to* **mitalum@mitvmc.mit.edu**

## XV MANAGEMENT

From Jacksonville, Fla., **Mano H. Chinnaswamy**, SM '92, who is a project manager at Vistakon, writes: "Busy with a new house, a new car, and especially a beautiful new baby girl. Nicaela was born January 22, 1993. We also didn't waste any time, #2 is due 2 February 1994!" . . . **Miren Etcheverry**, SM '83, reports from Cambridge: "I am head of the Latin America Group at Baring Asset Management and manage a portfolio of $550 million in equities invested in Latin America, including London-listed Puma fund." . . . **Eugene M. Moore**, SM '77, sends word from Scottsdale, Ariz.: "I am international administrator for St. James Bible Colleges with locations in Kiev, Ukraine; Moscow, Russia; and Minsk, Belarus. In the next three years, we are planning to establish five more bible colleges in the former Soviet Union." . . . **Bruce Blumberg**, SM '81, writes: "I left NeXT in the fall of '92 to enter the PhD program at the MIT Media Lab. The focus of my research is on understanding how we can apply ethologically inspired models of animal behavior, learning, and evolution to the problem of building autonomous, adaptive agents. A system based on my work was demonstrated at Siggraph this past summer. Ultimately, I hope to teach."

**Josephine Jimenez**, SM '81, reports: "My 18-20 hour workdays have not stopped. I am now working as portfolio manager at Montgomery Asset Management in San Francisco, where I joined as partner in 1991. I manage over $500 million of funds, including the Montgomery Emerging Markets Fund, an open-end, no-load mutual fund. Last February, I appeared as the guest on *Wall Street Week with Louis Rukeyser*. Despite my hectic schedule, I have managed to socialize with fellow Sloan graduates, including: **Tomas Nicolin**, SM '81, who, together with his wife, Ingrid, graciously hosted a dinner party for me in Stockholm last winter; **Walliwan Varavarn**, SM '81, who is now the busy mother of three boys and a manager of real estate investments in Thailand; **David Golden**, SM '81, **Nobuko Kato**, SM '82, and **Peter Cooperstein**, SM '81, have also been amongst those I have seen recently." . . . **Richard Yonker**, SM '74, informs us that he has a new job. He is VP for finance and information systems at the Ask Group in Alameda, Calif. . . . From Brooklyn, N.Y., **Thomas C. DeCanio**, SM '77, reports: "I have joined Chase Manhattan Bank as VP for network planning." . . . **Susan B. Weisenbeck**, SM '91, is an investment officer at the MIT Treasurer's Office. She and her husband, Kurt, who reside in Milton, Mass., announce the arrival of their son, Thomas, on October 2, 1993. . . . News from **Michael Halloran**, SM '83: "I just moved back to Cincinnati to take a new job as senior VP for strategic and marketing services of Optimum Group, a marketing and visual communications company."

**Michael Chaudoin**, SM '91, is manager of hardware developers at Apple Computer in Cupertino, Calif. . . . **Michael Kasinkas**, SM '82, is general manger at AngioMedics in Plymouth, Minn. . . . From Buxton, N.C., **Burnham S. Gould, Jr.**, SM '56. reports: "I am preparing to retire to the Outer Banks of North Carolina. We have had a vacation home in Frisco for many years. Now we are building a retirement home in Southern Shores to supplement it. Vacationing classmates are always welcome." . . . **Christopher H. Price**, SM '87, writes: "After Nova Pharmaceutical was acquired by Scios (aka California Biotechnology) in late 1992, I joined a seed venture capital company, Medical Innovation Partners, based in the Twin Cities. In addition to doing VC activities, I am heading up one of our early-stage companies and doing business development for a later-stage company. My family has expanded to three children (8, 5, and 3 years old) with three matching hamsters. Petitions for acquiring dogs, horses, and other beasts of burden (to parents) have been submitted but are unlikely to be approved by management (Susan)." . . . **Dan Beardslee**, SM '86, reports: "I have been a principal with a seed capital fund in Michigan for the last six years. My wife, Sue, and I have an 18 month old girl named Laura Rose and are expecting our second child in January."

**Luis Valencia**, SM '93, sends word from San Antonio, Tex., where he is VP for administration at Inverworld, Inc.: "I have a very exciting position as supervisor and coordinator of the whole back office of this small financial group, entailing the Accounting & Control Department, the Info System Department, as well as the office manager section. The company's small size gives me the exposure I also want with the promoting and the trading activities. Inverworld caters to Latin American investors (both individuals and corporations), particularly in Mexico. The group has opened an office in Venezuela and plans to settle in Argentina very soon." . . . **Elizabeth Coley**, SM '87, reports: "I retired from UCSD Medical Center in December to spend more time with my wonderful son, Ian, and to prepare to move the family to Cincinnati next summer for Brian's continuing training in pediatric radiology." . . . **Eric Larson Gunness**, SM '93, is project manager at General Cinema Corp. in Chestnut Hill, Mass. He writes: "Greetings to all Sloanies! Hope all is well with everyone. We had a fun two years so let's stay in touch!" . . . **Leslie L. McCafferty**, SM '90, is a systems analyst at Blue Cross & Blue Shield of Florida. She writes: "Joshua Elias and Charlotte Eliza-

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Gretchen A. Young, SM '86
Cristian De la Huerta, SM '87
Alec D. Smith, PhD '89


beth McCafferty were born on March 8, 1993." . . . **Bill Gillett,** SM '85, reports from New York City: "I joined a recent software start-up as VP for business development. Cross/Z International is a pioneer in fractal-based decision support and predictive modeling software."

From Ottawa, Ontario, **Oscar Hauptman,** PhD '86, sends word: "In September 1992, I was appointed associate professor with tenure at Carleton University in Ottawa, and am conducting research sponsored by the Managing Technological Change in Manufacturing Program. On the same date, I was appointed senior associate at the Graduate School of Business at Melbourne University in Australia, teaching in the master of management (technology), MBA, and executive MBA programs there." . . . **Joseph Chow,** SM '81, MCP '81 (XI), and **Selina Chow,** SM '81, reside in Brookline, Mass. They announce the arrival of Kathryn Lauren on September 13, 1993. Kathryn is sibling to Joanna (age 7) and Jason (age 5). . . . From Prague, **Christopher P. Bolster,** SM '93, reports: "I am now in an intensive course of Czech, preparing to work on a project in Slovakia for McKinsey International. There are many thousands of fellow Americans here, attracted to the historic city and the thriving, rapidly privatizing economy. I would like to hear from fellow Sloan alumni/ae, especially those who went on the last two Eastern Europe trips." . . . **John E. Osborne,** SM '65, is director of finance at Apple Computer, Inc., in Cupertino, Calif. He writes to tell us: "We have just moved into our dream home—after four years of planning and building." The new home is located in Saratoga, Calif.

From New York City, **Marjan Ghahramani,** SM '92, reports: "I am still working as a consultant at A.T. Kearney, specializing in financial institutions. I just came back from 10 days in Italy, where I attended the wedding of **Silvia Ullo,** SM '92. It was a beautiful wedding—many Sloanies from classes of '91, '92, and '93." . . . **Kenneth A. Matheson,** SM '51, writes: "I am enjoying a very quiet retirement in Pointe Claire, Quebec." . . . **Christina T. Schoen,** SM '85, is VP at Creditanstalt in New York City. . . . From Redwood City, Calif., **Eileen Mendel,** SM '91, reports: "I am president of the Mendel Group, Inc., a management consulting firm focused on biotechnology, pharmaceuticals, and other biomedical technologies." . . . **Scott V. Seidewitz,** SM '92, writes: "Despite graduating from Sloan and entering the conservative ranks of corporate America, my political ambition and idealism remain undiminished. In addition to surviving Procter & Gamble Co.'s recent downsizing, I helped manage the Clinton/Gore field campaign in Cincinnati and carry the banner of free market liberalism as best as I can in the stodgy Mid-West. On a less personal note, **Kuljinder Chase,** SM '92, recently went on his first date in over three years. Congratulations should be sent directly to him in New York." . . . From Winnetka, Ill., **Donna Williamson,** SM '76, reports: "I have a new position as senior VP at Caremark International. The company was created as a 100 percent spin-off last November. Scott is working as VP for corporate development at FMC in Chicago. Our son, Erik, plays the baritone horn and squirt hockey, while Christopher is in Montessori school."

**John Urdan,** SM '88, writes: "I live in Los Angeles; love LA, but (believe it or not) miss 'the people' in Boston. Working at MCA, a large entertainment conglomerate, in the music group. Call if you are in town (818-777-4182)." . . . **David Bolocan,** SM '92, is an associate at Mercer Management Consulting in Washington, D.C. He writes: "I am working in Seoul, Korea, until March 1994, and staying at the International hotel. I invite all Sloanies to give me a call and drop by for a visit." . . . **Chuck Bland,** SM '80, is VP of Asia Pacific for Owens-Corning Fiberglas in Toledo, Ohio. He writes: "I was recently assigned responsibility for all OCF operations in Asia Pacific—relocating family to new regional headquarters in Hong Kong. Named as member of the board of directors of Asahi Fiber Glass (Japan) and LOCC Fiber Glass (Korea)." . . . **Tom Taylor,** SM '91 (XV, II), and **Julia Putnam,** '89 (III), SM '91 (XV, III), were married in April 1993. Julia is manager for emerging procedures at Ethicon Endo-Surgery Co. with Johnson & Johnson. Tom is a manufacturing planner for the Delco Chassis Division at General Motors. . . . From Boston, **Paul Reeder,** SM '85, reports: "I recently celebrated my third anniversary since founding PAR Capital Management, Inc., which controls an aggressively managed private investment partnership. Fund assets have reached $50 million, up for $3.5 million at inception."

**Charles Kazuo Akiha,** SM '91, and **Yoko Bang Akiha,** SM '91, have moved from London to Tokyo. Charles works at Booz Allen's Tokyo office and Yoko now works at Apple Computers. . . . **Isadore T. Katz,** SM '84, has been named VP for marketing at Meta-Software, Inc., in Cambell, Calif. She was VP for marketing in the IC Design Division at Cadence Design Systems, Inc., in San Jose, Calif. . . . **Robert I. Heller,** SM '67, a partner at Riddell, Williams, Bullitt & Walkinshaw, in Seattle, Wash., has been elected to the executive committee of the Washington State Bar Association's environmental land use section. Heller's law practice specializes in land use and local government permitting and regulation. He has served as editor-in-chief of the state bar's land use law newsletter and as a member of the Seattle Planning Commission.

**John A. Thompson,** SM '61, of Middlebury, Vt., died on August 3, 1993. He served with the U.S. Marine Corps. Thompson worked for Union Carbide in Hartford, Conn., before moving to Middlebury, 30 years ago. He was a marketing manager for Polymers Plastics in East Middlebury and was later self-employed in sales. He was a member of the Sheldon Museum, a lifelong member of the Lake Champlain Maritime Museum, and the Mystic Seaport Museum in Connecticut.

### SLOAN FELLOWS

**Bob Nafis,** SM '65, sends word from Greenlawn, N.Y.: "I fully retired this past May. Had a great time at our class '64/'65 reunion at the Shawnee Inn in October, organized by **Witt Langstaff,** SM '65, and **Hank B. Ferguson,** '50 (IX), SM '65, with 22 people." . . . From Rapid City, S.D., we receive word from **J. Duff Erickson,** SM '65: "I am beginning my 16th year as professor and head of the Department of Mining Engineering at South Dakota School of Mines. I enjoy the opportunity to work with students who will be involved in providing the minerals we need to sustain our

# CourseNews

way of life in the future while protecting the environment." . . **John T. Howley,** SM '73, is a consultant on international housing and real estate matters, based in Solomons, Md. . . . **Richard A. DeCoste,** SM '77, was named president and COO of the manufacturing unit of Decora Industries, Inc., a polymer-technology-products concern in Fort Edwards, N.Y. Previously, he was president of Shelter Materials Group, a unit of CertainTeed Corp. in Valley Forge, Pa. . . . **Richard G. Bruner,** SM '64, writes from Battle Creek, Mich.: "I retired from DLA and am now consulting on systems and working in real estate." . . . **Stephen N. Gerson,** SM '89, is medical director of the Division of Behavioral Health at Peer Review Analysis, Inc., in Boston. He was recently appointed to the board of directors at *Exceptional Parent* magazine.

From Annandale, Va., we receive word from **Reuben O. Schlegelmilch,** SM '55: "I retired ast technical director at the Office of R&D at the U.S. Coast Guard Headquarters, U.S. Department of Transportation, in Washington, D.C. I am presently doing part-time engineering consulting." . . . **George Rugge,** SM '42, is retired and living in Winter Park, Fla. . . . **Thomas J. Aylward,** SM '74, is president of Sandusky Plastics, Inc., in Sandusky, Ohio. . . . **John W. Bard,** '51, is a year-round resident of Sun City, Ariz. . . . **David R. Chittick,** SM '69, was the keynote speaker at the October 1993 Hong Kong Management Association Annual Convention. He sends us a reprint entitled "Who Scores Best on the Environment" from the July 26, 1993 issue of *Fortune*. AT&T, Chittick's employer, is rated number one out of ten top leaders. The article states that AT&T "is also steering an impressive course. In 1990 the telecommunications giant established goals for reducing air emissions, CFCs, solid waste, and hazardous waste. Under the direction of David R. Chittick, AT&T's VP of environment and safety, the company had either surpassed its goals or was ahead of schedule for meeting them by the end of last year. To engineer ozone-depleting emissions out of its operations, for instance, AT&T invested $25 million to develop an array of alternative technologies. One, called Low Solids Spray Fluxer, eliminates the need for CFC solvents that clean the excess flux from electronic circuit boards. Now AT&T is selling this technology to some 25 other companies, among them IBM."

## SENIOR EXECUTIVES

**David M. Hall,** '76, writes: "I retired as regional manager at Electronic Data Systems in Saginaw, Mich. I have accepted a new position as assistant professor in the business division at Northwood University in Midland, Mich." . . . From Harare, Zimbabwe, **Samuel Vengai Rushwaya,** '87, reports: "I am currently mobilising funds for a 2,050-hectare plantation project involving development of 550 hectares of citrus and 1,500 hectares of sugarcane." . . . **Thomas L. Shealy, Jr.,** '91, has retired from Eastman Chemical Co. and moved to Kiawah Island, S.C. . . . From Yokohama, Japan, **Gai Kobayashi,** '83, reports: "As of June 25, 1993, I was nominated president of Mitsubishi Electric Building Techno-Service, Inc., which is providing maintenance and support services for building facilities such as elevators, air-conditioning systems, and monitoring systems. The firm has 250 offices throughout Japan." . . . **Robert L. Pennock, Jr.,** '73, sends word from Denver, Colo: "I am engaged in strategic business and marketing planning for both for-profit and non-profit organizations." . . . **J. N. Panzarino,** '89, sends word from Northboro, Mass., where he is director of government programs at Saint-Gobain/Norton Industrial Ceramics. He writes: "The Government Programs Group is supporting Saint-Gobain/Norton in several important areas in advanced materials, i.e., diamond film (a recent $10-million ARPA Award), super abrasives (a recent $500K award for Innovative Wheels from DOE), and advanced ceramics (a recent $1.3-million award on solid free-form manufacturing and advanced ceramics)." . . . **M. Lee Hibbs, Jr.,** '90, has been named president and CEO at PLC Systems, Inc., in Milford, Mass. He was president and COO at Electro-Catheter Corp. in Rahway, N.J. . . . **Christopher Fay,** '85, has been named chair and CEO at Shell U.K. Ltd. (a unit of Royal Dutch/Shell Group) in London. He was previously managing director of Shell U.K. Ltd., and Shell U.K. Exploration and Production. . . . At the Ford Motor Co. in Allen Park, Mich., **W. Dale McKeehan,** '84, changed positions. He is now VP and general manager of the North American Vehicle Operations Division. He was general manager of the Body and Assembly Operations Division. . . . **Erik H. Van der Kaay,** '82, has been named to the board of directors of SSE Telecom, Inc., in McLean, Va. He continues as president of Allen Telecom Group in Solon, Ohio.

The Association of Alumni and Alumnae has been notified of the following deaths: **Patrick B. Lyons,** '61, of Vero Beach, Fla., on November 15, 1992; **Charles A. Ormsby,** '63, of Centerville, Mass., on March 11, 1993; **Lee W. Sloan,** '66, of San Francisco, Calif. on July 18, 1993; and **E. Balasubramaniam,** '90, of Worcestershire, England, on August 7, 1993.

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## MANAGEMENT OF TECHNOLOGY

The MOT Program Office received a newsletter from the class of 1990, which detailed fascinating news from various MOT 1990 alums. **Barbara Proud,** SM '90, traveled to the United States where she met with program office staff and Sloan professors. She also celebrated the Chinese New Year in Beijing with **Ann Kang,** SM '90. Ann has started a new job with the DHL Far East Regional Office in Hong Kong as project manager for information systems. . . . **Yves LeCars,** SM '90, reports that "life has been very busy since his return from Boston." He is now the European manager for emerging technologies for Kodak. He is in charge of a lab in France, as well as a large research department in the UK› and is a member of the European Research Board. . . . **Takenori Terada,** SM '90, and Kotoko have a new baby daughter, Kaoru, who was born on July 12, 1992, weighing 5.7 lbs. . . . **Hajime Yamada,** SM '90, visited the program office in September, 1993. He writes that he really does agree that "the Management of Technology Program is an exciting experience for a manager who wishes to be a top executive. The participation enables us to build a worldwide human network and also to broaden our outlook." . . . **B. Joseph Pine II,** SM '90, is now president of Strategic Horizons, Inc., in Ridgefield, Conn.

**Richard Shryock,** SM '92, took a new job recently as the program manager of technology for the Features and Options segment of the IBM PC Co. He is responsible for making the technology investment decisions, both internal and external, required to put IBM in a leadership position in this marketplace. He has also recently published an article in an internal IBM publication "directed towards the technical vitality of technical professionals." . . . **Lyle Hart,** SM '92, is currently the manufacturing business area manager for value systems at IBM. He arranged for the IBM PC Co. of the Americas to donate two Value Point personal computer systems—one each for the use of MOT Program participants and for the Sloan Fellows program. The Executive Education staff as well as the participants of both programs are deeply grateful for the donation. . . . **Koichi Hagishima,** SM '92, is now the manager of the Engineering Strategy Technology Research Department at NTT. He writes that he has shaved his mustache and looks younger! . . . **Amanda Chiu,** '93, has taken a position as technology development manager at Pratt & Whitney in East Hartford, Conn. . . . **Robert Gregori,** SM '93, was in Boston on business and stopped by the program office to visit. He is enjoying the challenges of his position as director at AT&T in Sao Paulo, Brazil. He writes that the MOT Program has been "instrumental to his activities at AT&T."

**Emmanuel Henry,** SM '93, traveled through the southern states during the summer with his wife, Michelle. He tells us that his former company has merged with a software-oriented subsidiary of Matra. In this new company, Matra Cap Systemes, he is working in the R&D division to improve the software development process, by increasing software reuse. He met with **Sigmund Kvernes,** SM '93, and his wife in Paris at the end of their vacation. . . . **Nevin Summers,** SM '93, is now the manager of business development at Ingenex, Inc., in South San Francisco, Calif. . . . **K. Paul Tyra,** SM '82(II), SM '93, and his wife are expecting twins in April. He visited the program office recently to say hi. . . . **Masahiko Tsuchiya,** SM '93, faxed the program office recently to let us know that he has been trying to "resocialize" himself to his home culture. "I feel myself growing up and find another [aspect of] myself that might be eligible for some different tasks." He says hello to all MOTs. . . . **Francis Yeoh,** SM '93, is now with the Information Technology Institute, a government-funded R&D lab under the National Computer Board in Singapore. He's interested in "nurturing entrepreneurship within the organization." He writes that there is a strong MIT presence in Singapore, and that there appears to be "great interest in MOT-like management programs" in his part of the world.—MOT Program, MIT, Room E56-290, Cambridge, MA 02139.

# XVI AERONAUTICS AND ASTRONAUTICS

**David Gold,** SM '90 (XVI, TPP), sends word from Gaithersburg, Md.: "For almost two years I have been working as a regional manager for the National Institute of Standards and Technology's Manufacturing Extension Partnership. We are establishing a nation-wide network of non-profit technical assistance centers for small and medium-sized U.S.-based manufacturers." . . . We receive news from **Philippe Kletzkine,** SM '83, in Oegstgeest, The Netherlands: "As of September 1993, I have been the manager of assembly, integration, verification, and launch operations (in short: AIV & LOPS) for the X-Ray Multi-Mirror Spacecraft (in short: XMM). XMM is a spaceborne observatory for X-ray astronomy, to be launched in 1999 by an Ariane rocket from Kourou, French Guiana. I have moved into this position at the European Space Agency's Space Technology Center E.S.T.E.C. in The Netherlands from my previous function of spacecraft propulsion engineer, also at E.S.T.E.C. XMM is 37 feet tall and that, coupled with the alignment control, and optical requirements of an astronomy satellite, makes for a pretty challenging assembly and testing program!" . . . **Joe Hale,** SM '52, ScD '63, sends word from Raleigh, N.C.: "Prentice-Hall just released *Introduction to Space Flight.* I conducted a home-study course on aircraft performance and design for the AIAA in October and am starting another on space flight in January 1994, again for the AAIA." . . . From Madison, Ala., **Ronnie Lajoie,** SM '87, writes: "I am hanging on to an increasingly undefined job on the increasingly fragile Space Station program in an increasingly unhealthy space industry. Why is the space industry dying? A lack of a long-term vision, a fundamental reason for being that the public and potential customers can strongly believe in. I am currently studying the possibility of switching careers (temporarily from aerospace engineering to cable television) to help put the space industry back on its feet."

The Association of Alumni and Alumnae has been notified that Colonel **Elmer T. Dorsey,** SM '43, of Pensacola, Fla., died on September 11, 1993. No further information was provided.

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# XVII POLITICAL SCIENCE

From Hong Kong, **John Frankenstein,** PhD '83, writes: "I published a study of the Chinese military-industrial complex for the Stockholm International Peace Reasearch Institute (1993). I was advisor to a U.N.-sponsored conference on defense industry conversion held in Hong Kong in June 1993." . . . Word from **Mitchel B. Wallerstein,** SM '77, PhD '78, in Falls Church, Va.: "I was appointed deputy assistant secretary of defense for counterproliferation policy in July 1993. In this new capacity, I have responsibility for formulating U.S. policy on limiting the further development and spread of so-called weapons of mass destruction (WMD), i.e., nuclear, chemical, and biological weapons, and their systems of delivery. I also spearhead the development of military doctrine and planning for those situations in which WMD proliferation has already occurred. With the end of the Cold War, the problem of proliferation has now become one of the central security concerns of the U.S. Government." . . . **Deborah R. Hensler,** PhD '73, director of the Rand Institute for Civil Justice and visiting professor of social science and law at the University of Southern California Law Center, was recently elected to the American Judicature Society's board of directors. Hensler's research on the civil justice system has focused on dispute resolution procedures in ordinary and complex personal injury litigation. She serves on the board of directors of the American Arbitration Association, the National Science Foundation's Law and Social Science Advisory Panel, the Public Policy Committee of the Society for Professionals in Dispute Resolution, a National Academy of Sceinces panel on the Federal Employers' Liability Act, and the Ninth Circuit Gender Bias Task Force.

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# XVIII MATHEMATICS

**Julian West,** PhD '90, sends word from New Haven, Conn.: "I am teaching mathematics at Temple University in Philadephia. I was on the third-place Canadian team at the World Puzzle Championships held in Brno, in the Czech Republic last fall. On a more personal side, I married Rose White in August 1992 and we have four cats."

*Alumni/ae may send info for Course News to* **mitalum@mitvmc.mit.edu**

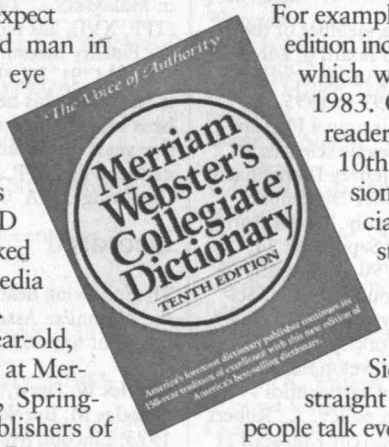
# XXII NUCLEAR ENGINEERING

**Susan Plomgren,** SM '88, writes from South San Francisco: "Ultrafast CT is the only non-invasive early warning device available for detecting coronary artery disease. Imatron, Inc., and Siemens Medical Systems are developing the machine, which is opening in hospitals and clinics around the country, offering the inexpensive, 15-minute test that can detect artheriosclerosis before any external symptoms appear. This technology is needed since the first symptom of heart disease is a fatal heart attack in over 300,000 Americans every year. Call 1-800-4MYHEART." . . . From Bethesda, Md., **Achilles G. Adamantiades,** PhD '66, reports: "I am currently a senior power engineer in the Infrastructure Division of the World Bank. I am the task manager for investments in the energy sector of Lithuania and Belarus. I also work on Estonia, Latvia, and Ukraine. In the last year, I was task manager for a study for 'power demand and supply options' for Lithuania, examining scenarios for the retirement of the Ignalina nuclear power plant. I monitor international activities in bringing about safety upgrades to Soviet-designed nuclear units that have safety deficiencies." . . . **Karl R. Goller,** SM '50, writes: "The state unemployment office could not believe that an MIT graduate was unemployed and could not find appropriate employment—but he is! Times are tough."

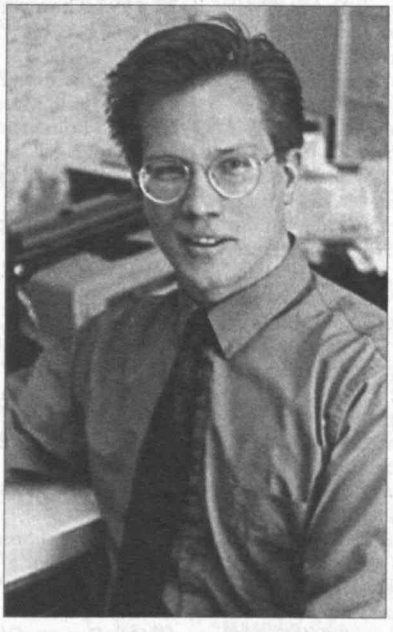
From Vienna, Va., **Shiv Seth,** SM '67, ScD '70, sends word: "As group leader for nuclear systems at Mitre, I continue to manage and contribute to programs for the Nuclear Regulatory Commission and the Defense Nuclear Facilities Safety Board. Recently, the NRC awarded us a contract to help develop technical basis and requirements for safety-critical software in nuclear plants." . . . **John H. Swailes,** SM '73, reports from Richland, Wash.: "I am employed by Washington Public Power Supply System in the position of plant manager at Unit 2. Unit 2 is an operating GE BWR of 1150 MWe capacity." . . . **William R. Corcoran,** PhD '71, of Windsor, Conn., writes: "Having retired as senior VP for quality at Tenera, I have started up a small business with my wife, Bonnie. Called Nuclear Safety Review Concepts Corp., it is providing on-

# An Editor of the Spoken Word

Most people expect a fusty old man in a green eye shade, not someone who looks like he comes to work on a skateboard," quips Brian Sietsema, PhD '89 (XXIV), when asked about the recent media blitz surrounding him.




The unlikely 31-year-old, pronunciation editor at Merriam-Webster, Inc., Springfield, Mass., the publishers of *Webster's Collegiate Dictionary*, has been the subject of several print, radio, and television stories. Every day, it is Sietsema's job to ferret out pronunciations of English words (including his own name, SEET-suh-muh). He calls everyone from delis to Persian rug dealers, and listens to the radio nonstop—talk shows, weather reports, National Press Club broadcasts, and even National Public Radio's *Car Talk*. Not for content, his coworkers note—he never knows what the forecast is—he just listens to the way words are spoken.



*Brian Sietsema, PhD '89*

He transcribes noteworthy pronunciations onto small slips of paper called "citations," which include everything he knows about the speaker's age, geographic location, and education. Since the first appearances of all dictionary entries are dated, he also records the date.

For example, the current (10th) edition includes "stressed out," which was first recorded in 1983. One change careful readers might detect in the 10th editionis the inclusion of regional pronunciations. Webster's strives to reflect the ways English is spoken in different parts of the globe, Sietsema says, going straight to the heart of how people talk every day.

Sietsema began his studies at the University of Michigan as a religion major. He liked languages so much—he can read 10 of them—he decided to switch to linguistics. He applied to MIT sight unseen, on the recommendation of a professor, and claims that his time here was the best four years of his life. His mentor was Institute Professor Morris Halle, whom he describes as an "unrepentent generalist."

Dictionary users can expect words such as "carjacking" and "letterbox format" (a style of putting movies onto video) in Merriam-Webster's 11th edition, sometime around 2003. But Sietsema doesn't expect to edit the next book.He wouldn't be surprised if his part-time teaching position at Westfield State College is a better indicator of his career path. □

*—Sherrie Saint John*

# CourseNews

going services to 7 utilities for 20 nuclear units." . . . **Stephen Goldberg**, SM '71, reports: "In July, 1993, I was awarded the exemplary service award at the Office of Management and Budget for my work on negotiating the purchase of highly enriched uranium originating from dismantled nuclear weapons in the former Soviet Union." . . . From Haifa, Israel, **John Wolfberg**, PhD '62, sends this update: "I've been splitting my time between Israel and the States—academic year at the Technion in Haifa and summers at Raden Research in New York City. Three of our four children are married and our youngest is about to be married. We currently have two grandchildren."

**Scott Vance**, SM '88 (XXII, TPP), writes from Richland, Wash.: "I recently joined the firm CH2M Hill, an environmental consulting firm. I am working in the area of hazardous waste remediation. Sometime during the summer of '94, I will be moving to the Boise, Idaho, office." . . . **Richard E. Boraks**, SM '59, reports: "In July 1993, I completed 30 years as a Connecticut Mutual life insurance agent, selling and servicing my clients, including many engineering graduates." . . . **James H. Wicks, Jr.**, SM '87 (XXII, XIII), writes: "I retired from the U.S. Navy and accepted a job as the West Tank Farm operations manager at Westinghouse Hanford Co. in Richland, Wash. . . . **Mat Waltrip**, SM '89 (XXII, II) reports: "I have left the Navy under the Voluntary Separation Incentive Program. Before leaving, I managed to complete the USS *Salt Lake City* (SSN 716) project nuclear work package $750,000 under budget. We were also able to reduce occupational radiation exposure by about 40 percent. I was awarded the Navy Commendation Medal for my efforts. My wife and I now live in Pleasanton, Calif. I have taken a project management position in San Jose with Pacific Nuclear Fuel Services Group. We help nuclear utilities store their spent fuel with our patented NUHOMS dry modular storage technology."

Fusion Power Associates of Gaithersburg, Md., announced its FPA 1993 Awards. Two MIT alums were honored. **Donald L. Cook**, SM '74, PhD '77, of Sandia National Laboratories, received the Leadership Award for 1993. Cook is director of pulsed power programs, including the light ion inertial confinement fusion program at Sandia. He was honored in recognition of his "successful, dedicated effort to demonstrate the potential of light ion fusion for both military and civilian applications," and for his "tireless technical and management efforts to provide credibility to this line of development under extreme pressure and in the face of widespread skepticism." **Scott W. Haney**, PhD '88, of the Lawrence Livermore National Laboratory, received the Excellence in Fusion Engineering Award for 1993. Haney is recognized for his "educational record, outstanding thesis, and contributions to computational physics" including his "contributions and leadership to the development of the SuperCode, which is now in wide use for fusion tokamak device design." This award was established in 1987 in memory of MIT Professor David J. Rose,

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PhD '50 (VIII), to recognize individuals in the early part of their careers who have shown outstanding technical accomplishment and leadership potential in the field of fusion engineering.

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## TPP TECHNOLOGY AND POLICY PROGRAM

**Robin Wagner,** SM '86, is a member of the MIT Alumni/ae Association Board of Directors representing Maryland, Virginia, and Washington, D.C., from 1993 to 1995. . . . **Paquita Zuidema,** SM '87, is now a PhD student in atmospheric and oceanic sciences at Colorado University." . . . **Jeffrey Dieffenbach,** SM '89 (TPP, III), and Jennifer Dieffenbach have an addition to their family. Taylor Aaron is a healthy baby boy, born September 24, 1993. . . . **Bob Pearce,** SM '90, is currently on assignment at the White House Office of Science and Technology Policy coordinating an interagency Aeronautics Working Group. The purpose of the group is to develop the national R&D goals and priorities of aeronautics as a statement of administration policy. . . . **Robert Margolis,** SM '92 (VI), is currently on staff at Tellus Institute. Congratulations are also in order—Robert and Ann are planning a May 1994 wedding.

Best wishes to **Lisa Prosser,** SM '92 (TPP, XV), and Walid—they are planning a 1994 wedding. . . . **Dominic Rodrigues,** SM '92 (XA), returned to Canada after receiving a degree from the London School of Economics. He has joined the staff of Jacques Whitford as a project engineer. . . . **Francois Cohas,** SM '93 (TPP, XVI), has been back in Paris for about one month. He reports that he has had some job offers from consulting firms and banks and will make a decision shortly. His girlfriend, Amy, was planning to visit Paris in November. . . . **Bruce Jacobson,** SM '93 (TPP, XV), has joined the staff of SNET in the Multimedia Services Department. . . . **Juan Pablo Montero,** G, has received an award from the Chile National Society of Hydraulic Engineering for the Most Promising Young Professional in Hydrology. This award is presented every two years by the 13th Congress of Hydraulic Engineering Conception in Chile on the basis of grades, papers written, and contribution to the area.

The following are notes taken during Richard de Neufville's recent visit to Asia: **Y. Grace Chen,** SM '87, has just become an associate professor of business administration at the Yuan-ze Institute of Technology in Taiwan, a new university sponsored by the Far East Group of Taiwan. In October she was the guest of the British Royal Academic of Sciences to participate in a workshop on the mitigation of natural disasters. . . . **Bill Tsai,** SM '88, ScD '88 (III), is now director of the Labor Inspections Administration for the City of Taipei. He essentially ensures that the local "OSHA" regulations are enforced for his metropolis of about 5 million people. Last year he ran for senator in the Taiwan Congress (The Legislative Yuan). . . . **Isna Soedjatmoko,** SM '87, is visiting Washington, D.C., as an environmental advisor for Mobil Oil Indonesia. . . . **Hotasi Nababan,** SM '93 (TPP, I), is special assistant to the director of corporate planning at Garuda Airlines and is working hard at facilitating closer TPP links with Indonesia. Thanks! . . . **Lep Sang Lee,** SM '82 (TPP, I), as of October is manager of corporate affairs for the IPCO Conglomerate of Singapore. Since leaving MIT he has picked up an MBA, worked for Coopers and Lybrand, and Arthur D. Little Consultants in Singapore, *and* had a son. He is president of the country's Adventuring Club and says he would welcome calls from TPPers interested in jungle trekking in Malaysia! . . . **Paul K.Y. Chan,** SM '91 (TPP, XVI), has moved to Hong Kong to join the Fidelity Investment Services. . . . **Kok-Kee Lim,** SM '91, EE '92 (VI), SM '93 (TPP, XIII), is renovating his new condominium and says he is looking forward to returning to MIT in a few years for another (fifth) degree.—Richard de Neufville, TPP, MIT, Room E40-252, Cambridge, MA 02139

## Deceased

The following deaths have been reported to the Alumni/ae Association since the *Review* last went to press:

**Charles W. Drew,** '18, '19; August 11, 1993
**Douglas M. Burckett,** '19, SM '22; July 27, 1993; Lincoln, Mass.
**Walter J. Creedon,** '19; August 25, 1993; Moorestown, N.J.
**Louise P. Horwood,** '19; August 5, 1993; Cambridge, Mass.
**Harold W. Merriam,** '20; September 27, 1993; Canton, Mass.
**Charles J. Dettling,** '22; June 18, 1993; Miami, Fla.
**Crawford Hallock Greenewalt,** '22; September 27, 1993; Greenville, Del.
**Harvard E. Moor,** '22; July 21, 1993; Jaffrey, N.H.
**John W. Strieder,** '22; October 25, 1993; Chestnut Hill, Mass.
**Lester B. Bridaham,** '23, SM '23; 1993; Bozeman, Mont.
**Eugene B. Mechling, Sr.,** '23; May 13, 1993; Lakewood, Colo.
**Daniel G.B. Thompson,** '23; July 30, 1993; Bloomfield, Conn.
**Austin G. Cooley,** '24; September 7, 1993; Sequim, Wash.
**James H. Doolittle,** SM '24, ScD '25; September 27, 1993; Pebble Beach, Calif.
**Herbert W. Kochs,** '24; June 5, 1993; Lisle, Ill.
**Robert M. Glidden,** '26; September 24, 1993
**Alan K. Laing,** '26; May 25, 1993; Urbana, Ill.
**Walter E. Caunt,** '27; October 7, 1993; South Yarmouth, Mass.
**Elmer F. Griep,** '28; October 20, 1993; Grants Pass, Ore.
**Edward Hartshorne,** '28; September 15, 1993; Fort Myers, Fla.
**George F. Badger,** '29; November 30, 1991; Champaign, Ill.
**Olof P. Pierson,** '29, SM '32; November 3, 1993; Caribou, Me.
**David H. Wilson,** '29; September 19, 1993; West Newton, Mass.
**Charles H. Hamilton,** SM '30; September 29, 1993; Marlborough, Mass.
**Cyril R.B. Harding,** '30; August 16, 1993; Burbank, Calif.
**Paul H. Kimberlin,** '30; July 26, 1993; Pearce, Ariz.
**Christopher J. Chamales,** '31, MAR '31;

November 2, 1993; Chicago, Ill.
**William Bowman Cutter**, '31; September 12, 1993; Waterford, Va.
**George Leo Hickey**, '31; July 27, 1993; Saugerties, N.Y.
**Antonio F. de la Torre**, '31; December 16, 1985; San Juan, P.R.
**John A. Bellizia**, '32, SM '34; September 6, 1993
**Francis T. Gowen**, '32; October 9, 1993; Newton Highlands, Mass.
**Theodora Keith**, '32; August 28, 1993; Bethel, Vt.
**Robert M. Loeb**, '32; August 17, 1993; Pinellas Park, Fla.
**Eugene F. Lynch**, '32; October 17, 1993; Oakmont, Pa.
**Archie Riskin**, '32; July 17, 1993; Newtonville, Mass.
**Perley A. Coffin**, SM '33; July 31, 1993; Gloucester, Mass.
**Robert G. Holt**, '33; August 30, 1993; Montpelier, Vt.
**Ferdinand M. Johnson**, '33; September 3, 1993; Delmar, N.Y.
**Samuel Lieben**, SM '33; January 27, 1993; Fort Lee, N.J.
**Richard C. Molloy**, '33; October 2, 1993; Sun City Center, Fla.
**Charles F. Payne**, '33; February 9, 1993; Canandaigua, N.Y.
**Wallace S. Adams**, '34; January 10, 1991; Jacksonville, Fla.
**Christian Eckhardt Born**, '34; August 27, 1993; Falmouth, Maine
**Joseph A. Hahn**, '34; October 16, 1993; Maryknoll, N.Y.
**Emerson Philip Kron**, '34; July 30, 1993; Fairport, N.Y.
**Arthur J. Manson, Jr.**, '34; July 15, 1993; Gonzales, Tex.
**James J. Glenn**, '35; July 26, 1993; Wayne, Pa.
**Brydon Greene**, '35; February 16, 1993; Cashiers, N.C.
**Joseph Lawrence Haggerty**, '35; September 4, 1993; Hooksett, N.H.
**John W. Hansborough**, SM '35; July 30, 1993; Austin, Tex.
**G. Fred Lincoln**, '35; October 2, 1993; Buzzards Bay, Mass.
**Arthur C. Marquardt, Jr.**, '35; July 31, 1993; Dedham, Mass.
**Louis C. Maspero**, '35; October 5, 1993; North Quincy, Mass.
**Frank B. Matthews**, '35; April 2, 1993; Petersburg, N.Y.
**Harold William Parker**, '35; September 27, 1993; Acton, Mass.
**Edward E. Christopher**, '36; September 6, 1993; Silver Spring, Md.
**William R. Saylor**, '36, SM '41; October 2, 1993; Brewster, Mass.
**Ellington D. Wade, Jr.**, '36; September 3, 1993; Naugatuck, Conn.
**Edwin T. Herbig, Jr.**, '37; September 30, 1993; Waterville, Minn.
**Leo B. Moore**, '37, SM '49; August 1, 1993; Lexington, Mass.
**Peer J. Cody**, '38, SM '41; September 20, 1993; Barrington, Ill.
**Donald S. Macdonald**, '38; August 29, 1993; Washington, D.C.
**Robert H. Park**, '38, SM '39; June 23, 1993; Houston, Tex.
**David E. Reid, Jr.**, SM '38; July 10, 1993; Warwick, R.I.
**Edgar B. Taft**, '38; October 4, 1993; Stockbridge, Mass.
**William C. Love**, '39; June 28, 1992; Nashville, Tenn.
**Arthur S. Merrow, Jr.**, SM '39; July 30, 1993; Hamburg, N.Y.
**Irving N. Smith**, '39; June 10, 1993; Saratoga, Calif.
**Anne A. Zemansky**, '39; September 25, 1993; Paradise, Calif.
**John E. Martin**, SM '40; October 15, 1993; Algoma, Wis.
**George Wheeler Carnick**, '40; August 28, 1993; Caldwell, N.J.
**Jean Lionel Lewis**, '40; August 22, 1993; Worcester, Mass.
**John T. Muller**, '40; August 14, 1993; East Falmouth, Mass.
**John E. Martin**, '40; October 15, 1993; Algoma, Wisc.
**Oscar M. Alonso**, '41; August 28, 1993; Miami, Fla.
**William Guy Kussmaul**, '41; August 31, 1993; Belleview, Fla.
**Ross W. Rotzler**, SM '41; August 11, 1993; Marshall, Tex.
**Harris F. Hanscom**, '42; July 15, 1993; Barrington, R.I.
**Robert G. McAndrew**, '42; September 6, 1993; Pittsford, N.Y.
**Richard K. Walker**, '42; September 19, 1993; Convent Station, N.J.
**Charles A. Speas**, '42; October 9, 1993; Cockeysville Hunt Valley, Md.
**Elmer T. Dorsey**, SM '43; September 11, 1993; Pensacola, Fla.
**William V. Engels**, '43; April 16, 1993; Great Neck, N.Y.
**Maryalice Conley Moore**, PhD '43; September 1, 1993; Brewster, Mass.
**Whitney Newton II**, '43, SM '44; October 18, 1993; Franktown, Colo.
**Carolus M. Cobb**, '44, PhD '51; September 21, 1993; Newton Highlands, Mass.
**Iriwin M. Jennis**, '44; September 30, 1993; West Orange, N.J.
**Jerauld O. Johnson**, '44; December 24, 1988; La Jolla, Calif.
**James McIntosh**, '44; May 9, 1993; Monterey, Calif.
**Sheridan C.F. Ing**, '45, '47; October 8, 1993; Honolulu, Hawaii
**Lyle F. Forward**, '46; June 15, 1993; Rock Island, Ill.
**Robert W. Jevon**, '46, SM '51; September 16, 1993; Lincoln, Mass.
**William A.H. Barton, Jr.**, '47; July 14, 1990; Gold Beach, Ore.
**Herbert B. Callen**, PhD '47; May 22, 1993; Sarasota, Fla.
**Allyn R. Lumbert**, '47; July 4, 1993; Burlington, Mass.
**Howard Howlett Montgomery, Jr.**, SM '47; June 16, 1992; Annapolis, Md.
**Clarence K. Morehouse**, PhD '47; September 25, 1993; Longwood, Fla.
**Manuel Cerrillo Valdivia**, PhD '47; August 26, 1987; Bosque De Echegaray, Mexico
**Alexander Bavelas**, PhD '48; August 16, 1993
**Carleton H. Boll**, '48; October 18, 1993; Rumson, N.J.
**Daniel J. Horan**, '48; July 5, 1993; Carmel, Ind.
**Charles H. McDonnell, Jr.**, '48; March 7, 1993; Purcellville, Mass.
**William R. McEwen, Jr.**, '48; October 9, 1993; North Chatham, Mass.
**Edward A. Sevian**, '48; May 2, 1993; West Roxbury, Mass.
**Frederic J. Vezina**, '48; July 24, 1990; Buffalo, N.Y.


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**Robert J. Boyden**, '50; July 28, 1993; Gillette, N.J.
**Sherman P. Spaulding**, '50; October 26, 1985; Wayland, Mass.
**Harris B. Stone**, '50; June 16, 1993; Alexandria, Va.
**Thomas Leslie Thompson**, '51; August 30, 1993; Thayne, Wyo.
**Joseph L. Tilenis**, '50; August 22, 1993; Greenbelt, Md.
**Kenneth L. Holmes**, '51; May 3, 1993; Huntsville, Ala.
**Walter R. Beckett**, '52, SM '57; September 10, 1993; Sudbury, Mass.
**Raymond H. Bennighof**, SM '52; December 31, 1992; Phoenix, Md.
**William B. Farrington**, PhD '53; July 17, 1993; Laguna Beach, Calif.
**George Sargent Janes**, PhD '53; August 14, 1993; Lincoln, Mass.
**John L. Jones**, '53; August 11, 1993; Houston, Tex.
**William F. Holst**, '54, SM '55; December 22, 1992; New York, N.Y.
**Melvin Pollard**, '54; August 12, 1993
**David A. Brown**, '55; June 27, 1991; Los Alamos, N.M.
**Nathan C. Burbank, Jr.**, ScD '55; August 5, 1993; Tucson, Ariz.
**George F. Harper**, '55, SM '56; August 20, 1993; Concord, Mass.
**Gorken Melikian**, SM '57; October 11, 1993; Somers, Conn.
**Frank L. Galeener**, '58, SM '62; June 6, 1993; Fort Collins, Colo.
**Paul R. Getchell**, '59; July 18, 1993; Burlington, Mass.
**Marian Krzyzaniak**, PhD '59; April 14, 1993
**Raymond T. Shanstrom**, ScD '59; July 24, 1993; Stamford, Conn.
**James C. Madden, IV**, '60; August 9, 1993; Houston, Tex.
**Richard B. Morrill**, MAR '60; May 1, 1991; Minneapolis, Minn.
**Stanley Y. Ogawa**, SM '60; September 24, 1993; San Jose, Calif.
**Robert J. Glass**, '61; July 21, 1993; Los Angeles, Calif.
**Patrick B. Lyons**, '61; November 15, 1992; Vero Beach, Fla.
**John A. Thompson**, SM '61; August 3, 1993
**Jerry L. Adams**, '62; July 27, 1993; Columbia, Md.
**Charles A. Ormsby**, '63; March 11, 1993; Centerville, Mass.
**Domenic L. Giovachino**, '65; May 16, 1993; Annapolis, Md.
**Lee W. Sloan**, '66; July 18, 1993; San Francisco, Calif.
**Thomas M. Dooley**, '69; SM '71; October 17, 1993; Arlington, Mass.
**George F. Unger, III**, SM '69; August 11, 1992; Washington, D.C.
**Godfrey Otaigbe**, '77; April 17, 1979; Lagos, Nigeria
**Eugenio Ocampo, Jr.**, '78; 1993; Quezon City, Philippines
**Gerry A. Berlo**, '71; September 11, 1993; Sacramento, Calif.
**Carlos Eugenio Dominguez Vial**, PhD '81; August 26, 1993; Arlington, Mass.
**Thomas J. Kessler**, '86; December 19, 1992; East Rochester, N.Y.
**E. Balasubramaniam**, '90; August 7, 1993; Worcestershire, England

A week ago a colleague complimented the cover of the second edition of my book with George Almasi (*Highly Parallel Computing*). It seems he received an examination copy. This surprised me since we are just now sending in page proofs to the publisher for January availability. As best we can understand it, he received a blurb on the second edition, including a cover picture, and recently used the first edition. Strange. A related occurrence happened to me while waiting with my son for someone to arrive by train. We went to the library and Michael, who *loves* buttons, wanted to use the computer terminals there. So we went to the electronic books in print and looked up mine. Sure enough, the second edition was right there —but I was not listed as a co-author! Virtual reality reigns.

## Problems

**F/M 1.** We begin with a bridge problem that Jerry Grossman reports arose in a Sarnia, Ontario, sectional pairs game.

North
♠ K 10 9 6 4
♥ 3
♦ K Q 10 7 4 2
♣ K

West
♠ J 8 3
♥ 9 5 2
♦ 8 5
♣ J 9 6 5 2

East
♠ Q 7
♥ K 10 8 7 6
♦ 9 3
♣ Q 10 8 4

South
♠ A 5 2
♥ A Q J 4
♦ A J 6
♣ A 7 3

The contract is an ambitious 7 NT. West leads the 2 of clubs. How do you bring home the contract?

**F/M 2.** The late Robert High played a game in which two opponents took

*SEND PROBLEMS, SOLUTIONS, AND COMMENTS TO ALLAN J. GOTTLIEB, '67, THE COURANT INSTITUTE, NEW YORK UNIVERSITY, 251 MERCER ST., NEW YORK, N.Y. 10012, OR TO: GOTTLIEB@NYU.EDU*

# PuzzleCorner

turns rolling a die. The loser is the first one not to improve on the other player's last roll. What is the probability that the first player will win?

**F/M 3.** Dudley Church recommends the following problem from *The Puzzling Adventures of Dr. Ecco*, written by my NYU colleague, Dennis Shasha.

There are 13 logicians in a room, all wearing jackets. On the front of each logician is a name tag and all the logicians have different names. On the back of some of the jackets is a big X. Each of the logicians can see the back of everyone else's jacket, but not his own. Initially, someone comes into the room and says, "At least one of you has an X on his back." The problem is for each logician to figure out whether he has an X or not.

They do this in the course of several rounds. In each round, the logicians who have not yet decided whether they have an X on their backs speak in alphabetical order. Each logician either says:

"I don't know whether I have an X on my back," or "I don't have an X on my back," or "I do have an X on my back and at least one other logician does also but has not yet said that he does," or "I do have an X on my back and all other logicians who do have already said so."

They are not allowed to say anything else.

As soon as a logician decides, that is, announces, that he does or doesn't have an X on his back, he stops speaking. This is what happens: In the first round, four people decide. In the second round, three people decide. One decider in the second round says there are more X's. In the third round, the remaining six decide.

## Speed Department

If Greg Fulkerson is giving a demonstration of simultaneous chess games (not necessarily blindfolded), how can he arrange things so that you will never lose more than 1/2 of the games played (assume an even number of simultaneous games)?

## Solutions

**OCT 1.** Unfortunately, I inadvertently omitted part of the M/J 1 question that Tom Harriman calls "Superwiener." The correct Superwiener is as follows (now renumbered OCT 1).

The opening lead is the three of clubs by West. How does South make the contract of seven spades?

| | North | |
|---|---|---|
| | ♠ 10 9 8 7 6<br>♥<br>♦ A K<br>♣ A 10 9 8 7 6 | |
| West | | East |
| ♠<br>♥ 9 8 7 6 5 4<br>♦ 6 5 4 3 2<br>♣ 3 2 | | ♠ 5 4 3 2<br>♥ K Q J 10<br>♦<br>♣ K Q J 5 4 |
| | South | |
| | ♠ A K Q J<br>♥ A 3 2<br>♦ Q J 10 9 8 7<br>♣ | |

Peter Rauch found this double Vienna Coup (hence the name "Superwiener") to be just his cup (coup) of tea (beer?):

1. Ace of Clubs, throw a diamond
2. Spade 6 to Spade Jack
3. Ace of Hearts, throw Ace of Diamonds
4. Heart 3, ruff with spade 7
5. Spade 8 to Spade Queen
6. Heart 2, ruff with spade 9
7. Spade 10 to Spade King
8. Ace of Spades, throw Diamond King

9-13. Run South's Diamonds

**OCT 2.** Thomas MacDiarmid asks you to cut a triangle out of paper—an equilateral is best to start with. Then fold each of the corners upward so that the vertices meet; the result is a tetrahedron. This does not work for all triangles. MacDiarmid wants you to determine which triangles can be folded into a tetrahedron with just three folds, one for each vertex. The following solution is from Robert Moeser.

Consider the triangle ABC with interior angles a, b, c. In order for any two vertices to meet when folded, it is clear that each side of the triangle must be divided into two equal lengths. Figure 1 shows the triangle with midpoints M, N, and O labeled as well as additional deductions about angles along the fold lines.

In figure 2 we see the cones which are formed when AM is rotated about MO and BM is rotated about MN. In order for A and B to meet at the new vertex T, the cones must intersect. Each cone uses twice the angle between the fold line and the triangle edge. In order for intersection 2a+2b>180. Since a+b+c=180, we can infer that c<90. By repeating the indentical argument for each set of cones, the requirement for triangle ABC is simply stated as "no angle greater than 90 degrees."

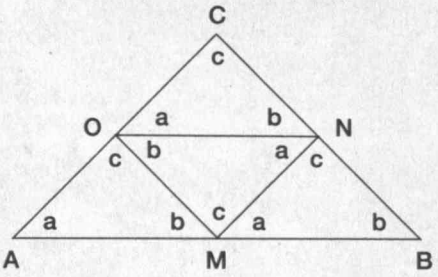



Figure 1

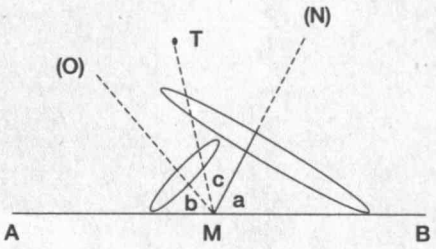



Figure 2

**OCT 3.** Nob Yoshigahara wants you to replace each letter by a unique digit (excluding zero).

$$\frac{AB}{CDE} + \frac{FG}{HI} = 7$$

The following solution is from Edward Sheldon:

AB/CDE must be less than 1, therefore FG/HI must be greater than 6, which means HI must be less than 20, thus H=1. Since C not 1, AB/CDE must be less than 1/2, thus FG/HI must be greater than 6.5. Viable combinations of HI and FG are found as follows:

| HI = | 12 | 13 | 14 | 15 | 16 | |
|---|---|---|---|---|---|---|
| 6.5*HI | 78 | 85 | 91 | 98 | -- | <=FG |
| 7*HI | 84 | 91 | 98 | -- | | >FG |

Since the two fractions must reduce to a common denominator, if HI=15, either E or G must be 5, therefore, I≠5, and I=2, 3, or 4. The possible solutions for HI and FG are:

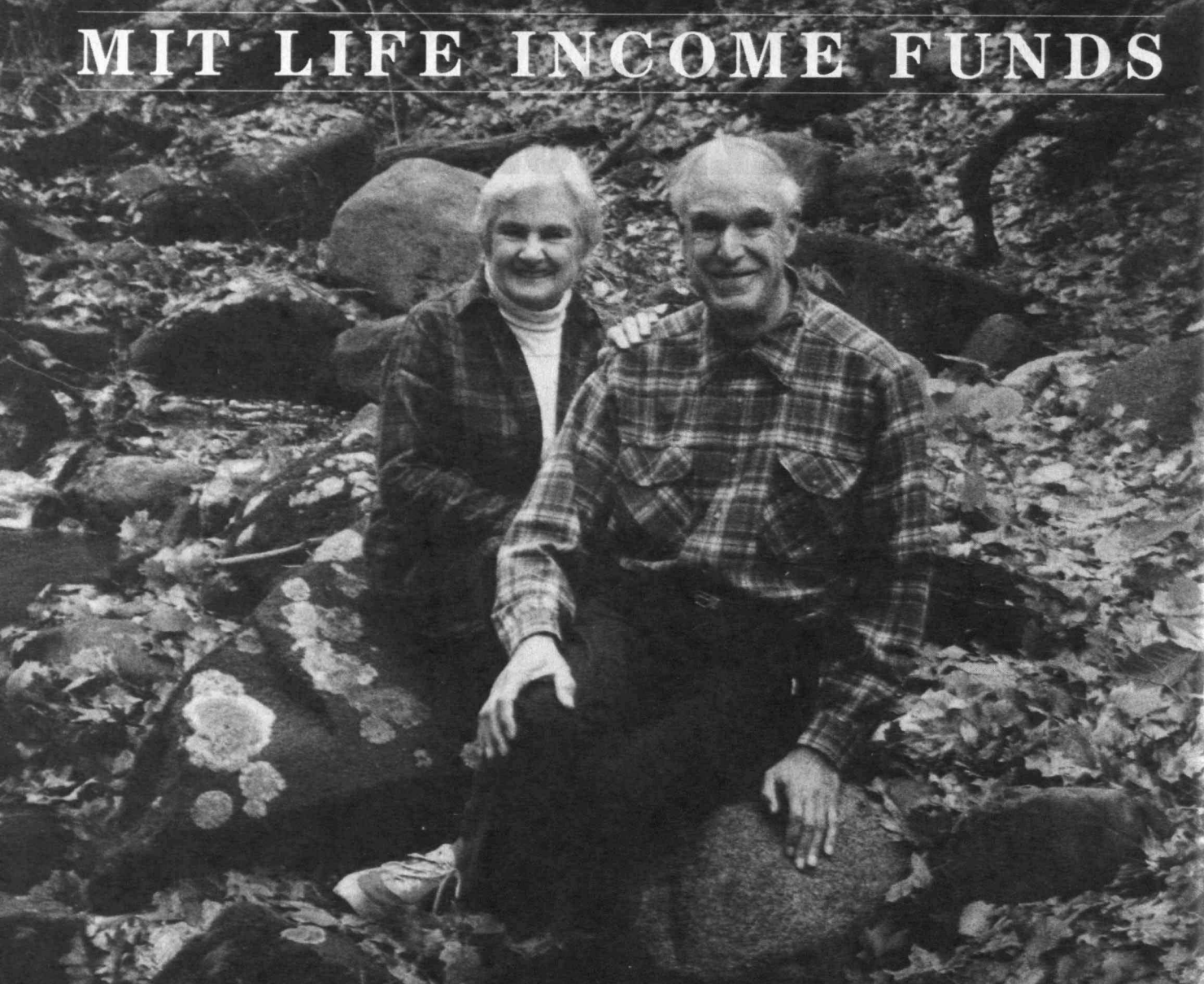
HI=12, FG={78,79,83}
HI=13, FG={85,86,87,89}
HI=14, FG={92,93,95,96,97}

There are 12 possible solutions. For each one, A&B come from a set of 5, with only 5*4=20 combinations. 20 * 12 = 360, which is small enough for an exhaustive search with a hand calculator. The search resulted in :

95/247 + 86/13 = 7

*Continued on Page MIT 30*

# MIT LIFE INCOME FUNDS



## MR. AND MRS. PETER M. RINALDO

HOME: Briarcliff Manor, New York

CAREER: After graduating from MIT with an S.B. in chemical engineering in 1944, Mr. Rinaldo was commissioned as an ensign in the U.S. Navy, which sent him to Princeton and back to MIT to become a radar officer. In 1946, he completed his naval career as a lieutenant (junior grade) aboard the heavy cruiser, the U.S.S. Macon, married, and in 1947 returned to MIT to earn his master's. He then joined the Dewey and Almy Chemical Company and spent his entire career there and with W.R. Grace, which acquired Dewey and Almy in 1954. He subsequently served as vice president of Grace's Industrial Chemicals Group and vice president of the General Industrial Products Group.

Since retiring in 1982, Mr. Rinaldo has been enjoying himself. He is president of the board of trustees of the Ossining Public Library; he drives a fire truck as a volunteer for the Briarcliff Manor Fire Department; he writes and publishes books; and he likes to hike, ski and canoe with his wife Dorothy.

LIFE INCOME FUND: Peter M. (1944) and Dorothy W. Rinaldo Fund in the Karl T. Compton Pooled Income Fund.

QUOTE: "We chose to invest in a Life Income Fund specifying that the remainder go to scholarships because we wanted others to have the same opportunity to go to MIT that I did; and because, in the meantime, the investment increases our current income. We chose the Compton Fund because Karl Compton was the president of MIT when I was there and a trustee of Dorothy's alma mater, Western College for Women in Oxford, Ohio, and we much admired him."

**For more information** about gifts of capital, write or call D. Hugh Darden, W. Kevin Larkin or Frank H. McGrory at MIT, 77 Massachusetts Avenue, Room 4-234, Cambridge, Massachusetts 02139-4307; (617) 253-3827.

Photo: Lane Photography, Ossining, New York

# DONORS' PROFILE

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**Canadian Rockies,** *July 12 -21.* Travel through the Canadian provinces of B.C. and Alberta.

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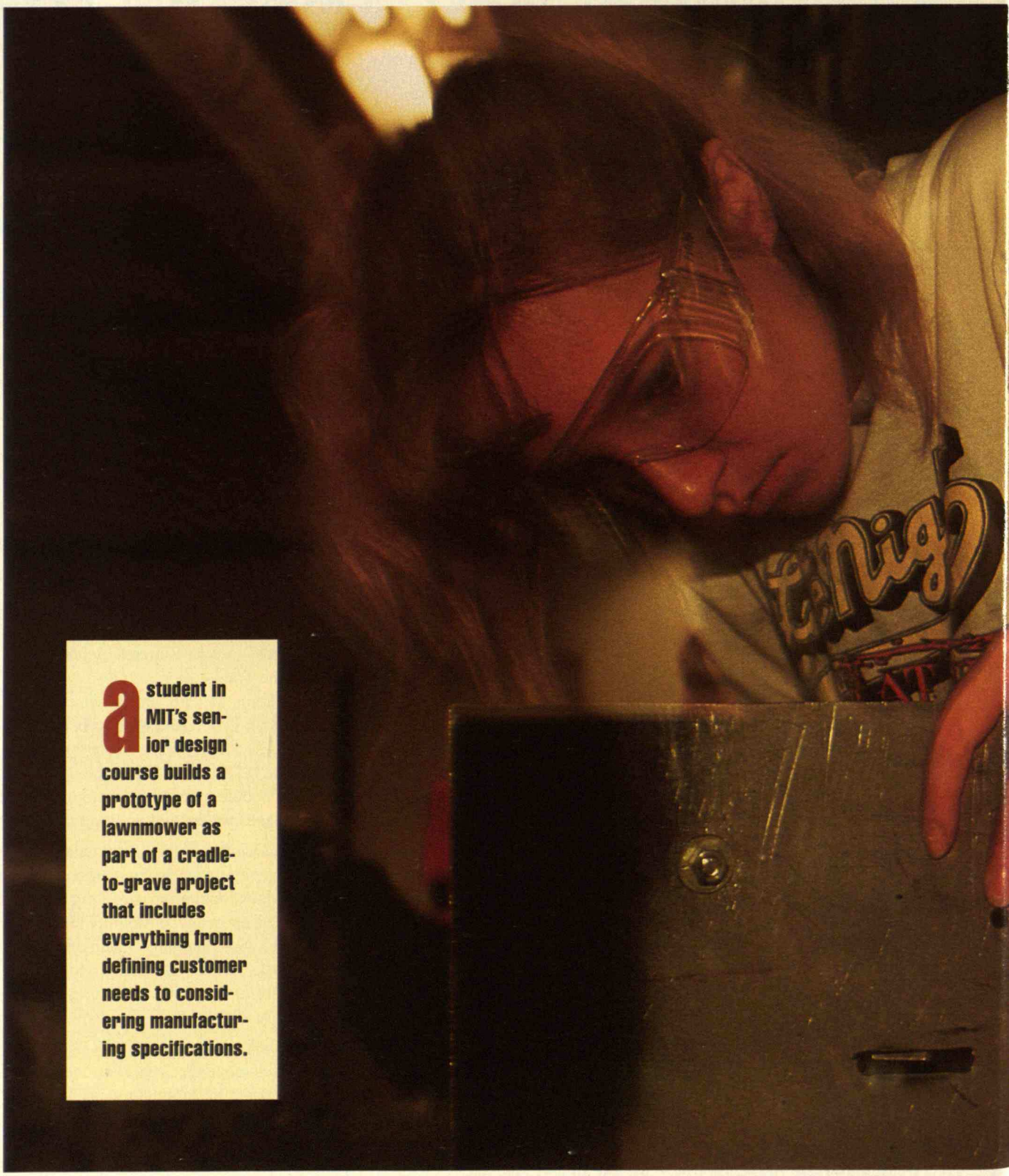
***Not all brochures available at the time of this printing. The above tours and dates are subject to change.***

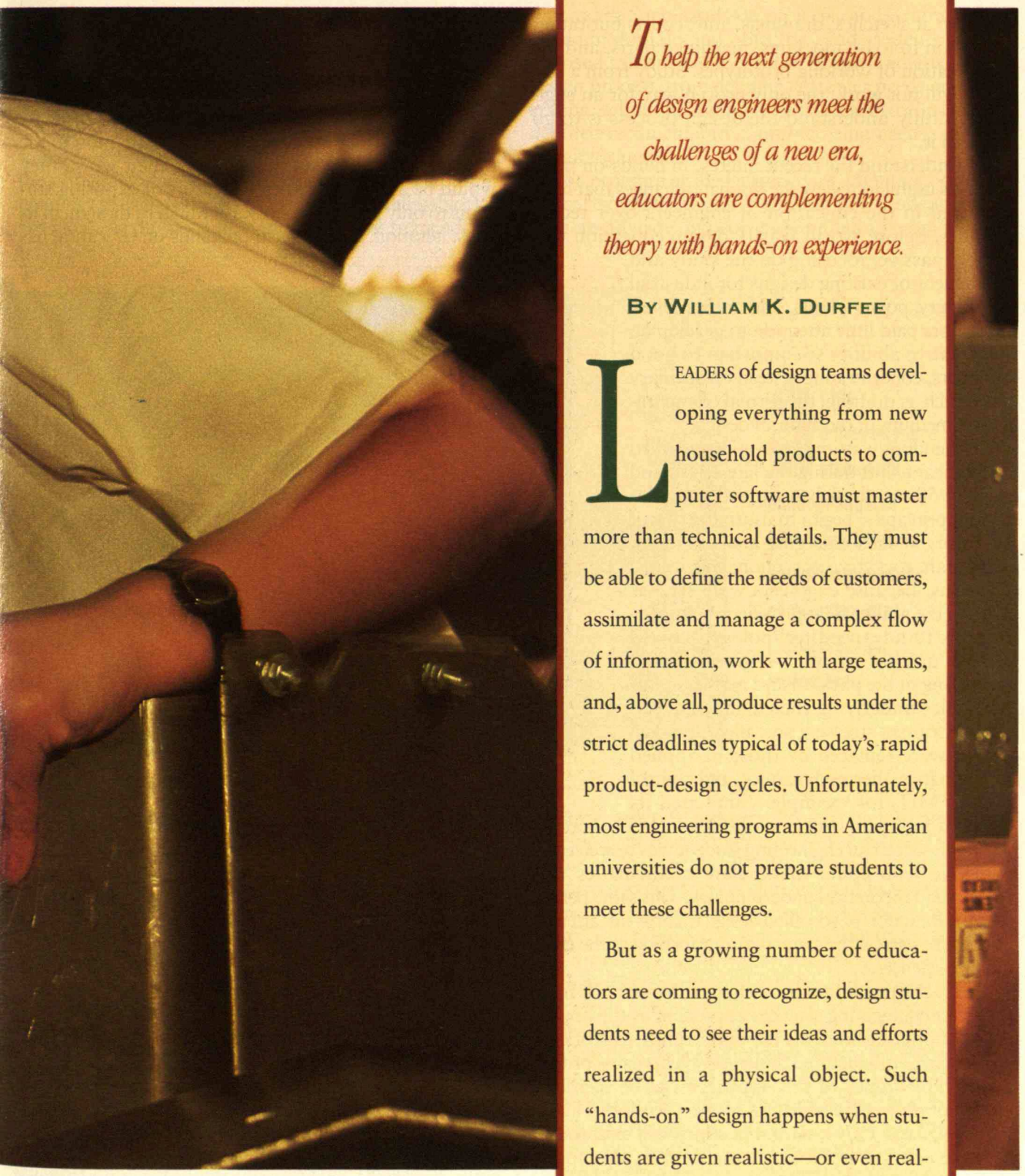
**For further information and brochures, please call 617-253-8265 or 800-992-6749.**

**MIT Alumni/ae Travel Program, 77 Massachusetts Avenue, Rm. 10-110, Cambridge, MA 02139.**



A student in MIT's senior design course builds a prototype of a lawnmower as part of a cradle-to-grave project that includes everything from defining customer needs to considering manufacturing specifications.

# Engineering Educatio



# n Gets Real

*To help the next generation of design engineers meet the challenges of a new era, educators are complementing theory with hands-on experience.*

**By William K. Durfee**

LEADERS of design teams developing everything from new household products to computer software must master more than technical details. They must be able to define the needs of customers, assimilate and manage a complex flow of information, work with large teams, and, above all, produce results under the strict deadlines typical of today's rapid product-design cycles. Unfortunately, most engineering programs in American universities do not prepare students to meet these challenges.

But as a growing number of educators are coming to recognize, design students need to see their ideas and efforts realized in a physical object. Such "hands-on" design happens when students are given realistic—or even real-life—design problems to solve, and when the outcome of student work does

PHOTO: L. BARRY HETHERINGTON

not stop at sketches, drawings, and reports but rather moves on to foam mockups, machined parts, and the presentation of working prototypes. Study from a distance will not work; the only proven way for an engineer to fully understand the design process is to go through it.

To understand the recent interest in hands-on projects, it is useful to review the dramatic changes that have occurred in the education of engineers over recent decades. Before World War II, design education was largely passive, focusing on the study and refinement of existing designs for industrial machinery, power plants, and automobiles. Educators paid little attention to developing the creative abilities so important to good designers, concentrating instead on ancillary skills such as drafting, the formal communication medium of mechanical design.

Tremendous wartime innovations sparked a significant shift during the late 1940s and early 1950s as physicists, trained in fundamental principles, began to usurp the role of inventors in such emerging areas as radar, jet aircraft, rocketry, encryption, and atomic weapons. Because engineers were seen as lacking the ability to apply scientific fundamentals to advanced technology, schools moved quickly to offer engineers more grounding in the physical and mathematical principles underlying the engineering sciences. Courses stressing so-called practical design were replaced by those in applied mathematics, thermodynamics, and control theory. MIT, for example, eliminated its required freshman course in drafting in 1953. Accordingly, the successful engineering student was perceived as someone who could manipulate mathematics and understand theoretical underpinnings. This same period saw the initiation of so-called design theory—an attempt to place design on the same rigorous footing as the engineering sciences.

Today the pendulum has begun to swing back from the strict engineering sciences approach, as the importance of offering students the opportunity to work on challenging, unstructured design problems gains prominence. The origins of this approach can be seen in a variety of project-based design courses developed in the late 1960s and 1970s, several of which still exist today. In these courses and many more recently developed ones, students tackle problems inspired by real-world goals that are often sponsored by industry, fostered by national design competitions such as General Motors' solar car race, or spawned by entrepreneurial faculty and students.

To be sure, if today's engineering schools simply let students construct products, paying no attention to the fundamental processes that underlie their work, they would be as guilty as prior educators of exposing students to only part of the story. Fortunately, though, in its latest iteration, the emphasis on hands-on education has not led to the abandonment of more analytically based design theory. Quite the contrary. By focusing on a realistic project and taking a design through to its completed product, today's students are encouraged to realize the importance of analytical approaches as well as recognize their limitations.

## "Hands-On" for Undergraduates

As one of the first schools to focus on hands-on design, MIT provides a good example of how such experience can be incorporated into the engineering curriculum at the undergraduate level. In one MIT course that has received worldwide publicity—known on campus as 2.70, Introduction to Design—some 200 students design and build machines for a face off at the end of the semester. Each student receives a box overflowing with parts that can be used to construct the machines, including gears, springs, DC motors, aluminum stock, rubber bands, cardboard, and sometimes unusual items such as a windup music box. In a recent year, the raucous, sin-

*WILLIAM K. DURFEE is associate professor and director of engineering education in the Department of Mechanical Engineering at the University of Minnesota, where he teaches "hands-on" engineering design. From 1985-1993 he was a faculty member in mechanical engineering at MIT.*

gle-elimination competition required students to build robotic machines that could collect empty plastic and aluminum drink containers: the winning student's machine was the one that ended up with the most trash in its bin after 30 seconds of competition.

Course 2.70, typically taken by sophomores, is well suited to reinforcing beginning students' appreciation of the principles of a structured design process. The competition's goal is clearly specified and the building blocks are fixed. At the same time, students have tremendous leeway in formulating and evaluating diverse ideas for building their machines. Harry West, the lead instructor for 2.70, views the hands-on component as a means for students to receive "immediate and persuasive" feedback in the design process. Because each student can say, "I built that," the experience encourages self-confidence and eliminates much of the mystery surrounding the creative design process.

Students see 2.70 as more than just an enjoyable experience: several have cited it as a major contributor to their later decision to become mechanical engineers. Based at least in part on the success of this course in providing undergraduates with an introductory window into the design process, universities around the world have introduced courses similar to this one.

Most undergraduate engineering programs also include at least one project-based design course to be taken during the senior year. The term "capstone design" is commonly used to describe such courses, whose mission is to integrate, through the vehicle of design, what the student has learned during the previous four years. Such hands-on projects can be more open-ended in domain and objective, and students can be exposed to considerably more of the cradle-to-grave design process, from defining customer needs and generating, selecting, and refining concepts to considering detailed technical and manufacturing needs, such as design for reuse.

The program at the University of Minnesota offers a typical example. Teams of three to nine students work with an advisor on projects originating from faculty research and local industry. Projects have included the development of cooling modules for railroad electric-motor controllers, diesel-exhaust samplers, automated slip detectors for friction clutches, and innovative techniques for engineering cars for cold weather environments. The course also serves as a means for students to participate in national competitions to design machines such as off-road vehicles and human-powered hydrofoils that skim across the water's surface. But because of the severe time constraints inherent in a single-quarter (10-week) course, many of the projects result in paper-based design feasibility reports and do not reach the fabrication and test stage. Thus, although the students go through a significant part of the design process, the hands-on component is missing. Some are able to get this experience by continuing their projects into the following quarter, but most are obliged to move on to other activities. Efforts are under way at Minnesota to add an introductory first- or second-year design course with a strong hands-on flavor to insure that engineering students do not graduate without hav-


**At the University of Minnesota, undergraduates developed a human-powered hydrofoil as an entry in a national design competition.**

PHOTOS: UNIVERSITY OF MINNESOTA HYDROFOIL PROJECT

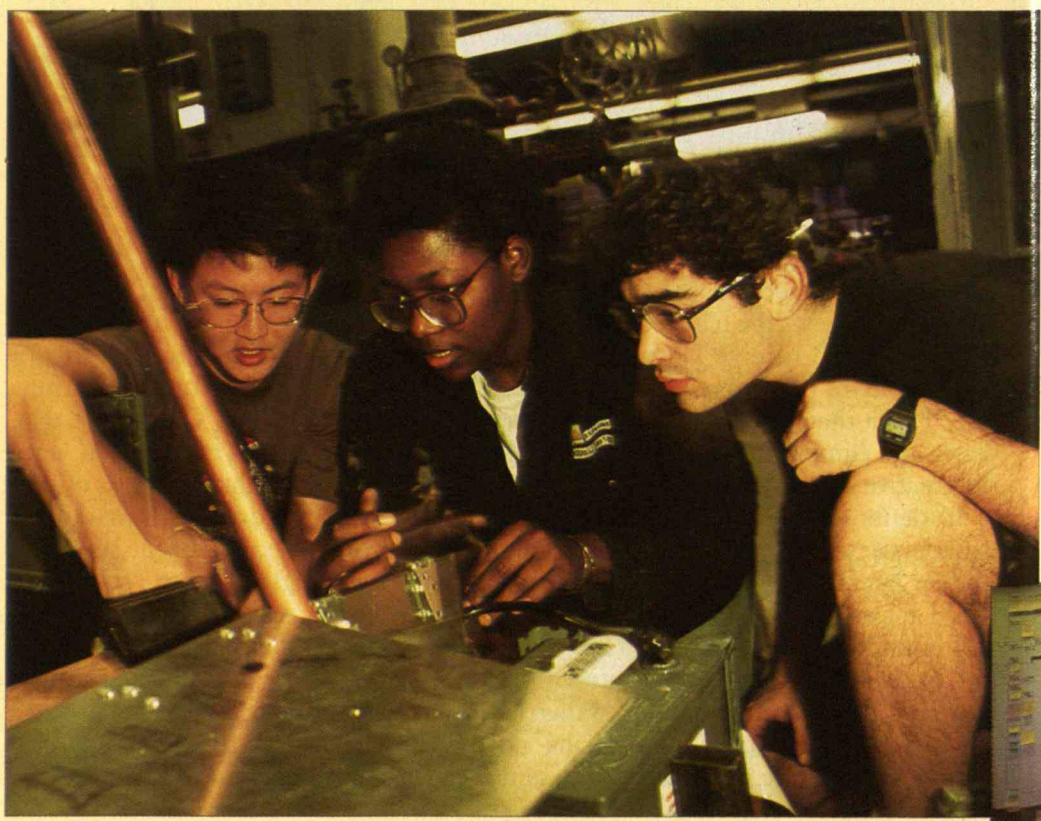
ing experienced this important part of design.

In MIT's senior-level mechanical engineering design course, called 2.73, Design Projects, over 100 students work on hands-on projects for a full semester in parallel with lecture components of the course. Students in this capstone design course recently built partial prototypes for visionary automobiles as part of the Cadillac 2000 project, sponsored by General Motors. Five teams of roughly two dozen students each tackled separate design needs. One team, for example, developed specific new designs for the elderly driver; another offered prototype cockpit designs that included anticipated technological advances. The overall project culminated in major presentations by the student teams before an audience of peers, faculty, MIT administrators, and engineers from GM.

To be successful, all such projects must respect the available time and experience of the students and the resources available for consultation and fabrication. Without a reasonable certainty of success, the experience can easily degrade into an exercise in frustration. Projects must also have a strict deadline marked by a major presentation and demonstration. In industry, letting a product launch date slip can often kill any chance of success in the market.

Another important element in the hands-on experience is structuring the course schedule to force at least two iterations through the design cycle. Fabricating a so-called breadboard—or rough prototype—early in the design process is one of the most effective means of bringing out the particular technological needs that will drive the ultimate design. Frequent communication helps to keep students and projects on schedule. Weekly memos to project supervisors describing work completed and anticipated problems enable difficulties to be detected early. Maximizing and simplifying access to catalogs, trade journals, computer-based design tools, fabrication facilities, and materials and supplies is equally essential. Although dealing with these practical needs may appear mundane to many educators, courses too often fail to offer students resources that in any way approximate those later available to them in practice. Easy access to up-to-date sources not only facilitates the educational experience but can prove critical to a young designer's ability to leverage them on the job in a new-product development program.

**In a recent senior-level design project at MIT, 4 teams of 28 students designed working models of electric lawnmowers to meet stringent air-quality standards set by the state of California. The machines, each targeted to a specific market, included innovations such as electronic controls and a mechanism that switches off the motor when the user jumps off. Here professors, students, and representatives of Ariens, the sponsoring company, put the vehicles through their paces.**



## Educating Design Leaders

A hands-on experience is no less important for training designers at the graduate level. At Stanford, a graduate course known as Mechanical Engineering 210 matches teams of three students with projects sponsored by companies participating in the Stanford Design Affiliates Program. Substantial projects can be taken through to completion during the three quarter (nine-month) course. Projects tend to have an electromechanical or computer-control flavor. Past examples have included a hybrid electric-vehicle powertrain system for FMC Corp., a lubricity tester for Schick Razors, and a window pinch detector for GM.

Perhaps the ultimate example of the hands-on approach at the graduate level is the New Products Program launched in September 1991 by Woodie Flowers of the Department of Mechanical Engineering at MIT. The program, which brings faculty and students from the School of Engineering and the Sloan School of Management together with industrial sponsors, has three objectives: to educate a new generation of product-design leaders, to synthesize new knowledge about the design process, and to create prototype products for sponsoring companies. The most important element of the program is its commitment to meeting all three objectives by doing design.

The sponsorship of each company joining the New Products Program triggers the creation of a new product design project and the formation of a design team. On the MIT side, the team includes four graduate students and three faculty members drawn from the Department of Mechanical Engineering, the Department of Electrical Engineering and Computer Science, and the Sloan School of Management. Design engineers and managers from the company also join the team. The goal, outlined in an explicit research contract, is to create a prototype new product within two years. That the company expects such a result is evidenced by its substantial financial support to the program—enough to pay for the tuition and stipends of the four graduate students, the time of the three faculty supervisors, and the costs of materials, supplies, and equipment as well as associated overhead costs.

The program began with two projects. Stanley Works, a Connecticut-based tool manufacturer, spon-


PHOTOS: L. BARRY HETHERINGTON

sored a team to design a handheld tool for the housing construction market that incorporates advanced technology developed by the project team. The Primary Care division of Becton, Dickinson and Co., based in Baltimore, sponsored a second project team to design and develop a new clinical diagnostic instrument for analyzing blood samples.

In some ways, a New Products Program project operates like any sponsored-research activity. The student members of the design team are admitted to the MIT graduate school through the normal process and must meet all of the regular degree requirements, including coursework and thesis. The contract with the sponsoring company is the conventional MIT sponsored-research agreement, designating one faculty member as the project's principal investigator. In many other ways, however, the program marks a substantial deviation from the typical university-industry collaboration in the field of engineering. The most important difference is that these are not the "make-work" activities that characterize the majority of student projects sponsored by industry—the prototype products actually matter to the company. Richard Ayers, chairman and CEO of Stanley, says the tool developed by the New Products Program could form the basis for a whole new family of products. Becton, Dickinson sees its new diagnostic instrument as central to the company's future growth. Each firm's substantial financial commitment to the program includes the cost of internal staff and facilities devoted to the development efforts. The expectation of results is reinforced by the fact that each company has scheduled a formal launch date for introducing its new product.

The experience of one of the second-year master's students on the Stanley team, responsible for analyzing and developing several subsystems for the tool, has closely mirrored the experience of a practicing engineer. The student spends his time in brainstorming sessions, on the telephone to vendors discussing the relative merits of materials, at the computer terminal exploring design options with the aid of spreadsheets and solid-modeling computer-aided design programs, and at construction sites talking with potential customers about their requirements. All of this directly contributes to meeting his academic requirements; the product prototype will form his master's research and the documented designs will become his thesis.

A benefit of tying the design projects in this program to thesis research is the continuity of the design team over most of the two-year project. In most other project-based design classes the team works on the design part-time for one semester, or in some cases two. In universities on the quarter system, design projects are typically cramped into an even shorter period. A full, two-year commitment by the team means the design can be carried out in a professional manner and include many more aspects of the entire process than is possible in a standard curriculum-based project. The program enables a holistic approach, wherein defining customer needs, working in teams, and managing project time effectively are as important to product success as properly calculating stress in a load-carrying beam.

Cooperative design demands an intimate collaboration: MIT is not creating the product for the company, but rather the company and MIT are working together, with each side contributing expertise. The company has the market knowledge, technical experience in an existing product line, and a manufacturing base. MIT offers expertise in advanced technology, links to research activities in many areas, and bright, creative, energetic design students. Communication is essential: ideally, each side must spend significant amounts of time at the other's facility. At least two Stanley engineers are present at the design meeting held each week at MIT. Electronic mail is also used heavily to help members of the design team communicate across several sites.

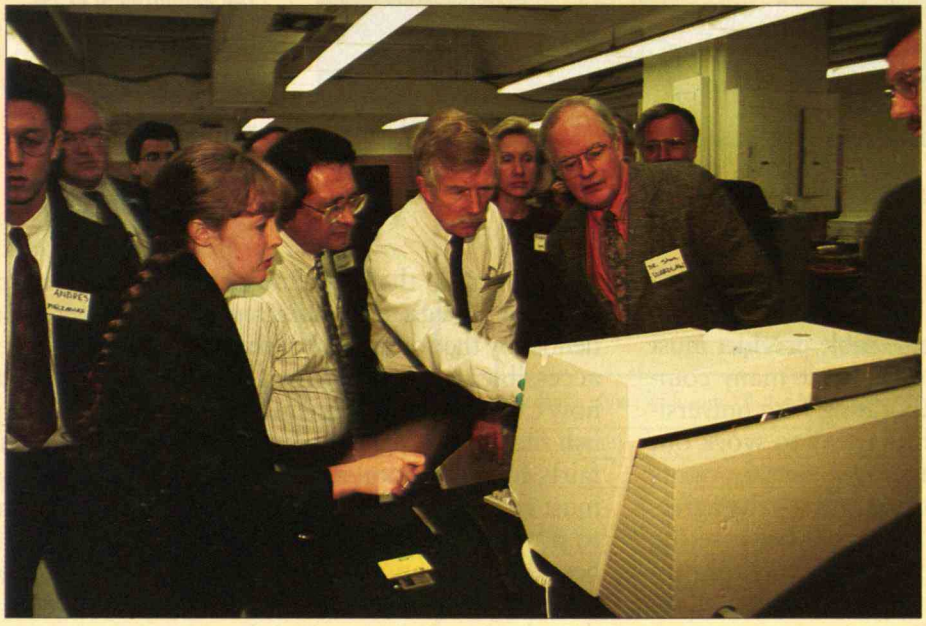
Meanwhile, an important mission of the New Products Program is understanding more about the process of product design and improving the way design is practiced. Indeed, analyzing and disseminating the results of design research may be where the program will ultimately have the most lasting impact. Each project serves as an in-house "laboratory" where ideas and theories about design can be nurtured, implemented, and evaluated. The importance afforded to design research is indicated by the program's inclusion of a fourth, doctoral-level graduate student. This team member typically does not take part in the day-to-day design activities but rather works on a thesis related to the overall design process.

One such doctoral student in the New Products Program is using the "interface" (control panel) being designed for the Becton, Dickinson instrument to test her ideas about the level of realism required for rapid prototyping of product interfaces in general—including such things as how knobs feel in users' hands as they move the controls through clickstops. This work included conducting surveys and testing computer-based prototypes with potential customers. Another doctoral student, who is working to develop more adaptable spreadsheet software for use by design engineers, tested his program by designing part of the Stanley tool. This intimate relationship with a real design process is a superb means of evaluating ideas, in contrast to the more common design research results that are derived through abstraction or testing on problems simplified beyond all practicality.

Why would a company have any interest in joining the New Products Program? Why not just do the job in-house? Clearly, if the product chosen for development

requires only an incremental change to an existing product line, in-house development would be more efficient. A New Products Program project is valuable when a significant change to a product line is required, typically spurred by the availability of new technology or by the need to apply an existing technology in a new way. Another benefit comes from letting a fresh team of creative designers tackle a new market opportunity, unfettered by company traditions. Admittedly, companies are also interested in the visibility the program will give them on the MIT campus, improving their ability to recruit the best students for employment.

Efforts on the Stanley project have now shifted to the company, where resources are being ramped up to meet the expected launch date; the Becton, Dickinson project is in the process of doing the same. Both teams developed new technology that represented a major departure for the company, and met their goal of providing prototypes demonstrating basic technology and packaging. Meanwhile, although the New Products Program is still in its infancy, former students who are now in positions directly or indirectly related to product design report that their experience in developing real products was a major factor in their hiring.



**A graduate student in MIT's New Products Program presents an instrument for analyzing blood samples to representatives of Becton, Dickinson and Co. Master's-level students work on two-year teams that include faculty members and engineers and managers from the sponsoring company to develop a significant new product.**

PHOTO: L. BARRY HETHERINGTON

## Constraints and Challenges

Despite the demonstrated success of including a substantial hands-on component in the undergraduate and graduate design curriculum, many challenges must be met and improvements made before hands-on learning can be universally accepted. Educators rightly worry about letting the fabrication experience dominate the students' education—it is too easy for students to immerse themselves in building their project at the expense of gaining an understanding of what they are doing. A proper balance must be established between completing the project and becoming familiar with the tools and processes that underlie successful design practice. One way to achieve this balance is to emphasize the ability to predict performance through engineering analysis and simulations. That is, rather than immediately turning to the lathe to create a shaft, a student should first use the skills learned in solid mechanics and materials courses to analyze the expected loads, determine an appropriate material and shaft diameter, and predict the onset of expected fatigue. Once the shaft is constructed, it should be tested to see if it meets the stated design requirements. This symbiotic combination of analysis and prototype fabrication separates the well-educated designer from the weekend garage inventor.

Other challenges to hands-on education are rooted in the traditional means for evaluating scholarly research, which do not include work that involves making a product. Although the type of educational training involved in a course like the New Products Program is a unique and valuable preparation for making a contribution to design research, it is still novel and may require new rules for evaluation.

Ownership of invention and patent rights for indus-

**Some faculty observing undergraduates participating in a hands-on project may ask, "Why are we teaching vocational trades?" The answer is that realization of a design is a critical part of learning the limits of materials, the importance of tolerances, and the time it takes to get things right.**

try-sponsored design projects presents another set of problems—particularly for endeavors like the New Products Program, where the deliverable product must have patent protection. However, because many companies have had experience collaborating with universities, the partners can usually find a way to work out equitable arrangements for assigning invention rights and establishing appropriate licensing and royalty agreements. The obstacles are surmountable because the goals of the academic and corporate participants are shared: both sides want to see the final product used. In the case of the New Products Program, for instance, the agreement specifies that if an MIT team member is responsible for a patentable discovery, the patent rights are held by MIT, but if a company member is responsible, the patent goes to the company. In the more likely case of joint ideas, the patent rights are held jointly by MIT and the company.

The issue of confidentiality raises a thornier problem that highlights the differing missions of universities and for-profit companies: here, the two sides do not share a common goal. To maintain a competitive edge, particularly when time to market can make or break a product, corporations need to control the flow of information tightly. On the other hand, academic institutions thrive on the free and open exchange of information, and academic respectability stems in large part from published information. For example, because the thesis of a master's student in the New Products Program documents a product design, it would normally be treated as confidential by the company. But theses are public documents accessible to all through the library system. Further, how can junior faculty members of the design team publish the results of their work so they can be evaluated fairly for promotion and tenure? Clearly, compromise must come from both sides if meaningful collaboration to produce new products is to continue. Team members might agree, for instance, to delay publication of academic papers for a reasonable period of time. Here, though, there are no easy answers.

Cost is another major barrier to implementing any hands-on design program, notably the obvious expense of laboratory and shop facilities. Since space is always at a premium in a university, providing and maintaining these facilities to meet the demands of a large-enrollment course requires the full support of faculty and administration. The costs of supplies for fabricated designs can also be substantial for a large-enrollment undergraduate design course. Each box of parts for students in MIT's 2.70 program costs well over $200; only generous donations from sponsoring companies make this program possible. This year, for the first time, some of the more expensive components were recycled to save costs.

An additional but often hidden cost of hands-on programs is the time required of both students and faculty. Students are easily drawn into the allure of realizing



PHOTO: L. BARRY HETHERINGTON

their own designs and usually spend well over the specified number of course hours working on their projects, particularly as the deadline for completion draws near. In laying out the scope and schedule for a hands-on course, instructors should recognize that students have other courses and activities that demand their attention. An end-of-semester time crunch that includes an intense design experience does nothing to reduce student stress.

There is no question that teaching a hands-on course, if done properly, is more time-consuming for faculty than a lecture-based course. No matter how often an instructor meets with design team students, it never seems to be enough. In some universities where support for design is strong, many faculty are willing and eager to contribute. In others, the weight is carried year after year by the few faculty who are truly dedicated to design and design education. But embracing the outside community can help leverage faculty efforts. Industry engineers (practicing or retired), adjunct faculty, recent graduates, and advanced graduate students all have significant design expertise that can be offered to students. The use of auxiliary instructors is particularly valuable in fabrication shops where students can benefit from direct, one-on-one interaction.

Finally, nondesign faculty observing undergraduates undertake a project that requires extensive fabrication and assembly may routinely ask, "Why are we teaching vocational trades?" The answer is that realization of a design is a critical part of learning the limits of materials, the importance of tolerances, and the time it takes to get things right. Designers with fabrication experience generally have a much better understanding of what can be specified in a design. Quite simply, seeing firsthand what works and what doesn't work is powerful reinforcement for truly understanding the basic engineering sciences taught in nondesign courses, and for gaining a fundamental respect for the design process. ■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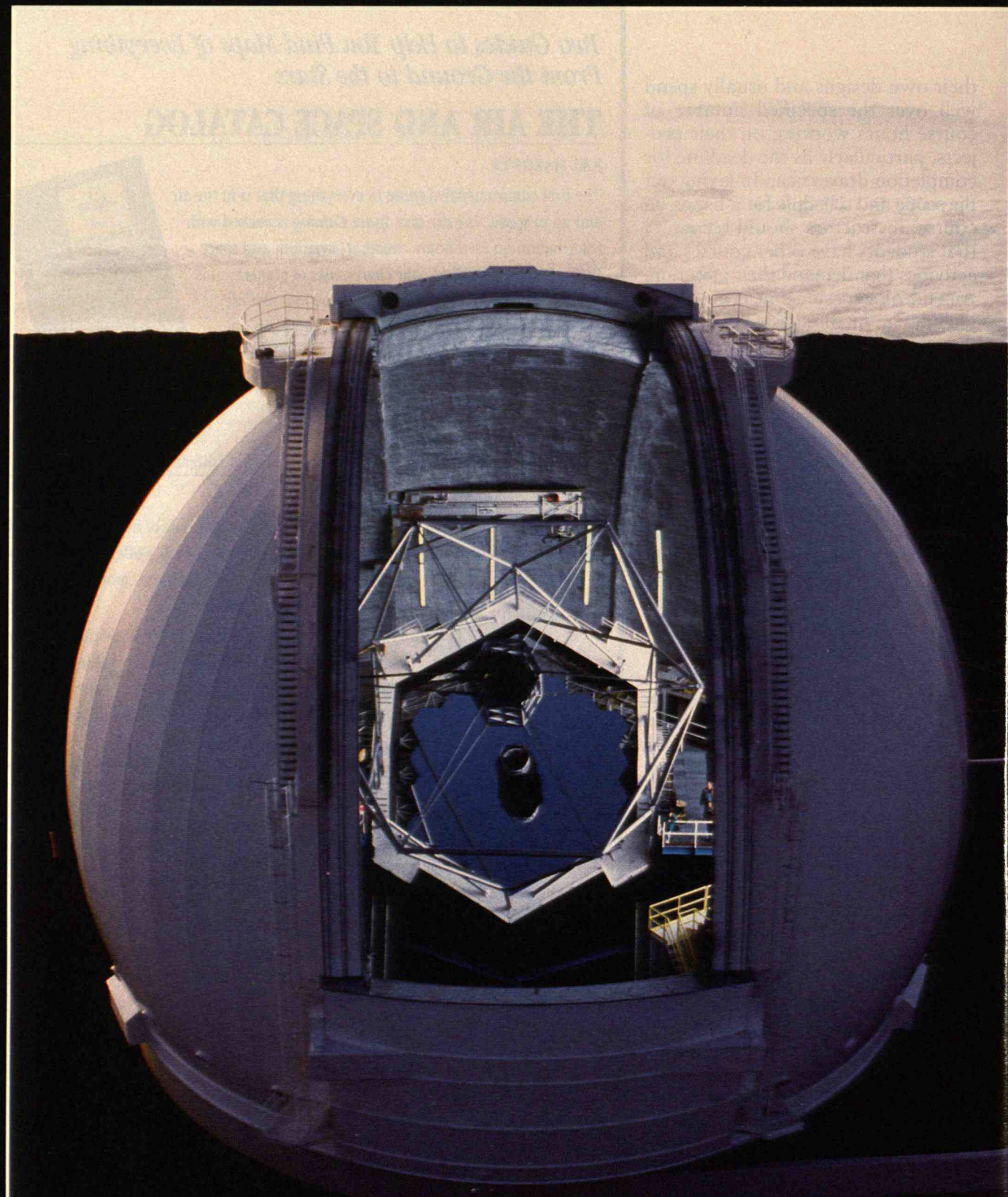


THE HEART OF THE WORLD'S LARGEST TELESCOPE—THE KECK, RECENTLY COMPLETED ATOP HAWAII'S MAUNA KEA VOLCANO—IS ITS 10-METER SEGMENTED MIRROR. DIGITALLY CONTROLLED PISTONS KEEP THE 36 SEGMENTS ALIGNED AS THE MIRROR IS AIMED ABOUT THE SKY. OPPOSITE: THE KECK'S BUILDERS INSPECT THEIR HANDIWORK.

# TELESCOPES FOR THE MILLENNIUM

BY FREDERIC CHAFFEE

FROM the moment in 1609 when Galileo first turned his crude two-inch telescope on the heavens, our understanding of the universe and of our place in it was irrevocably changed. A geocentric or even a heliocentric view of the cosmos was simply no longer tenable for anyone willing to consider the implications of Galileo's observations of lunar craters, Jovian satellites, and hundreds of thousands of never-before-seen stars. In the succeeding centuries, the hope that new and larger telescopes might permit discoveries of similar magnitude has driven astronomers and telescope designers alike to push technology to its limit.

The first half of this century saw a burst of activity in telescope design. "Refracting," or lens-based, instruments, which dominated astronomy for three centuries after Galileo, reached their technological apex in 1895, when the Yerkes telescope, with a lens a full meter across, was erected outside Williams Bay, Wis. But because lenses had become so massive that gravity was causing them to distort under their own weight, the next record-breaking telescope, dedicated in 1917, was of the "reflector" type. The 100-inch Hooker telescope on southern California's Mt. Wilson, like all major telescopes since, used not a lens but a concave mirror—an optical element that, unlike a lens, could be supported from behind without blocking light. The Hooker soon provided unequivocal evidence of the existence of galaxies outside our own.

*Radically new optics and computer-control techniques promise to open up the universe as never before.*

It also enabled astronomers to observe that the farther away a galaxy is, the faster it is receding from us—a discovery that led to the astonishing conclusion that the universe is expanding.

The more powerful 200-inch (5-meter) Hale telescope on Mt. Palomar, dedicated in 1948 after nearly 20 years in the making, produced yet another string of fundamental discoveries about the cosmos. In 1963, for example, spectroscopic observations revealed that some of the objects found by radio astronomers to be "radio-loud" were receding from us faster than the most distant known galaxy, a finding that implied that they were also much farther away. These "quasi-stellar radio sources"—quasars for short—are now believed to be solar system–sized "engines" located in the center of certain young galaxies, putting out more energy than a thousand ordinary galaxies. Thanks to the discovery of quasars, the universe now appears to be a far vaster place than anyone realized.

In the 1970s, the computer revolution spawned one of history's most intense periods in the design and construction of optical telescopes. This flurry of development has now reached a pivotal point. Designs in which computers harness the power of several mirrors stand ready to be scaled up to unprecedented proportions. New technology is allowing bigger, lighter mirrors to be made faster and is beginning to overcome centuries-old limitations on the sharpness of telescope images. In the last year, the most powerful telescope in history began initial tests atop an extinct volcano in Hawaii, and early trials of techniques for cutting through the distortion of the earth's atmosphere began to bear fruit. Within the next decade, advances in telescope design promise to push back our horizon even farther, allowing us to study the universe to ever fainter, more distant limits and with unprecedented clarity.

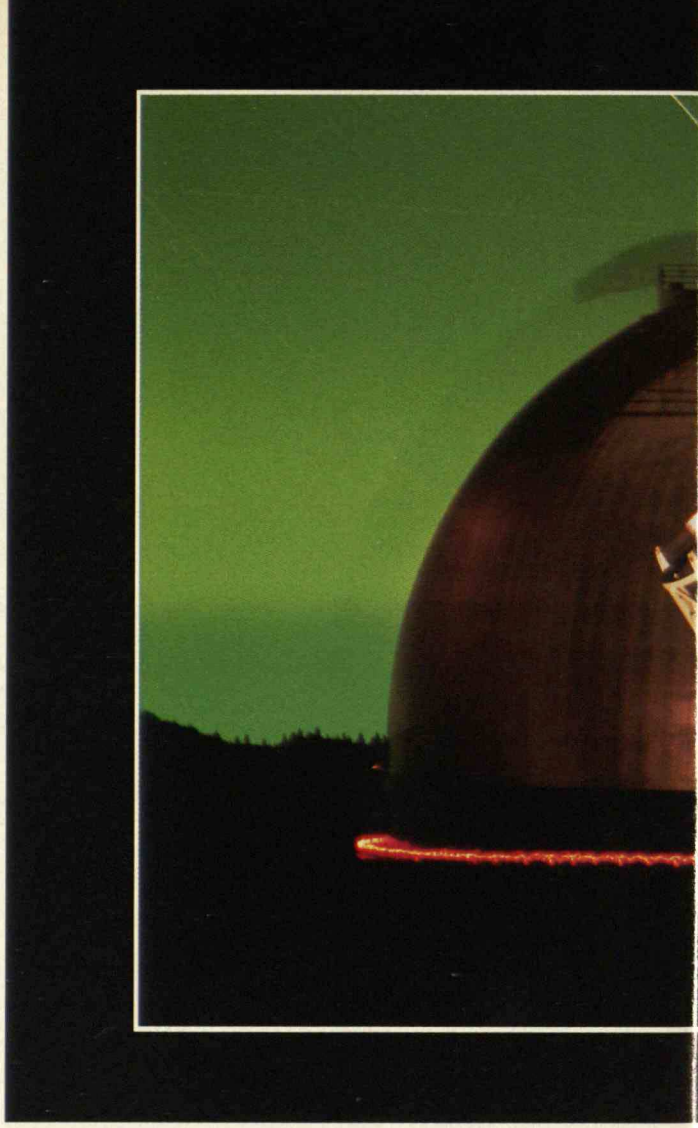
## The State of the Art

Much of today's renaissance in optical astronomy continues a quest that began immediately after the invention of the telescope: to increase the amount of light that is captured and brought to a focus so that astronomers can study fainter and fainter objects. Light-gathering power depends on the size of the "objective"—the optical element, whether lens or mirror, that first intercepts the light. Thus telescopes are among the few technologies where bigger really is better. Each new, larger telescope brings thousands more objects into view.

But just as astronomers at the turn of the century found themselves butting up against the limits of lenses, today's telescope builders must accommodate similar limits imposed by mirrors. The progression of larger and more powerful telescopes—with the attendant promise of new and amazing discoveries—can no longer be accomplished by simply scaling up the classic design of the Hooker telescope mirror. That era ended in 1975 with the commissioning of a Soviet 6-meter telescope, 1 meter larger than the Hale telescope on Mt. Palomar.

Located in the Caucasus Mountains at the southern border of Russia, the 6-meter was until recently the largest optical telescope in the world. But it has never performed at a level even approaching that of its predecessors. A major culprit is the sheer mass of its 42-ton mirror. Surprisingly, the problem is not the difficulty of supporting such a behemoth but the mirror's "thermal inertia." The mirror reacts to temperature changes so slowly that it is almost always hotter or cooler than its environment; thus it heats or cools the air immediately above it, distorting the incoming light.

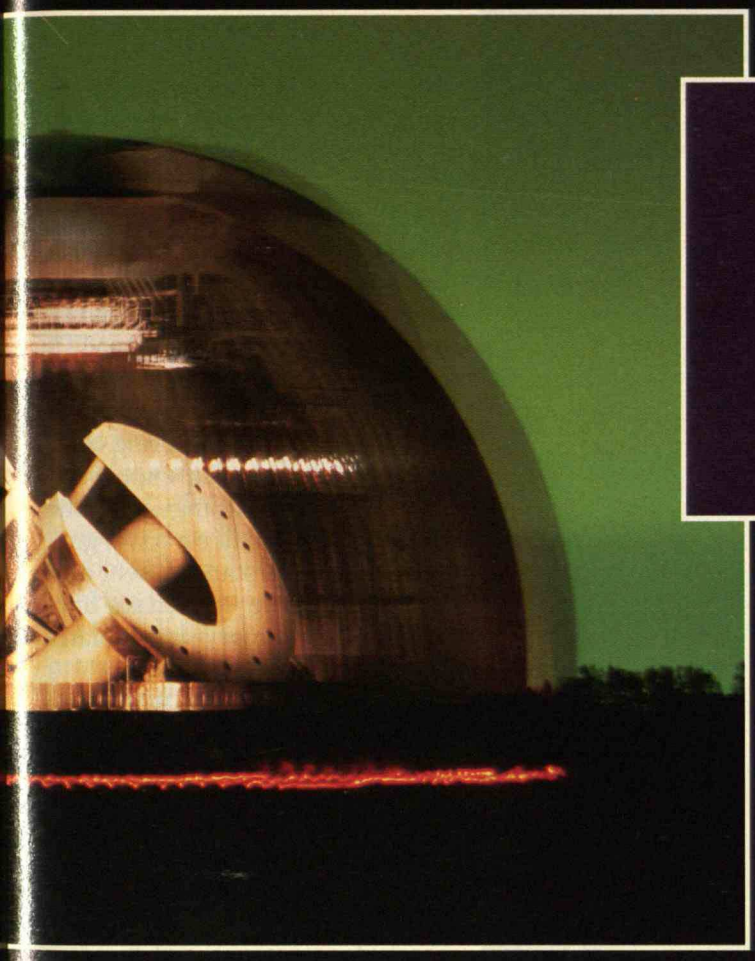
Because of this heat effect, images recorded by the 6-meter telescope have been disappointingly fuzzy. Astronomers measure the clarity, or "angular resolution," of an image in fractions of a degree called arcseconds. An arcsecond is equivalent to $1/3{,}600$ of a degree. Thus the moon, with an apparent size of half a degree of arc, is 1,800 arcseconds across. Although large tele-



*FREDERIC CHAFFEE is director of the Multiple Mirror Telescope Observatory—operated by the Smithsonian Institution and the University of Arizona—and former director of Arizona's Mt. Hopkins Observatory.*



PHOTOS PREVIOUS PAGE: ROGER RESSMEYER



MT. PALOMAR'S 200-INCH HALE REFLECTOR, FOR DECADES THE WORLD'S PREMIER TELESCOPE (SHOWN HERE IN TIME LAPSE), WAS THE SITE OF MANY ASTRONOMICAL BREAKTHROUGHS, INCLUDING THE 1963 DISCOVERY THAT QUASARS ARE THE MOST DISTANT OBJECTS IN THE OBSERVED UNIVERSE. ABOVE: A HALE PHOTO OF QUASAR 3C-273 .

scopes are theoretically capable of resolving celestial features a few hundredths of an arcsecond in diameter, the distorting effects of the earth's atmosphere limit resolution to about 1 arcsecond, or sometimes half an arcsecond on a really good night. But the resolution of the 6-meter telescope is considerably coarser, averaging 2.5 arcseconds.

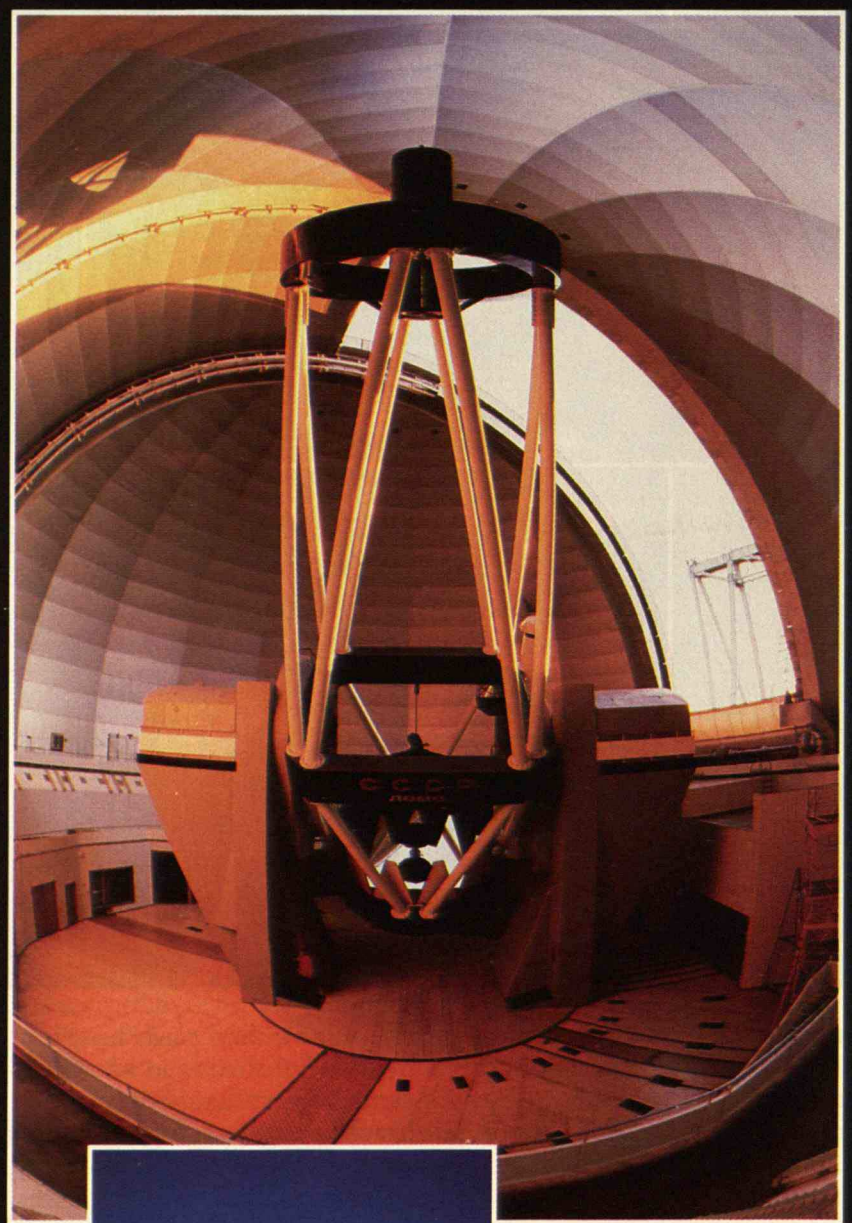
Later telescopes have benefited from a fundamental rethinking of the very nature of the instrument's objective. The first telescope to move radically away from the conventional single mirror was the Multiple Mirror Telescope (MMT), built atop Mt. Hopkins, 40 miles south of Tucson, by the Smithsonian Institution and the University of Arizona. This telescope, dedicated in 1979, circumvented many of the problems that were looming large for the post–5 meter era. Most important, as its name implies, it achieved its light-gathering power by combining several modest-sized telescopes—in this case, six 1.8-meter telescopes—held together in a common "optics support structure." Since the light-collecting surface increases with the square of the diameter, this gave the MMT the power of a telescope with a single 4.4-meter mirror, making it, at the time of its dedication, the world's third largest behind the Russian 6-meter and the Hale.

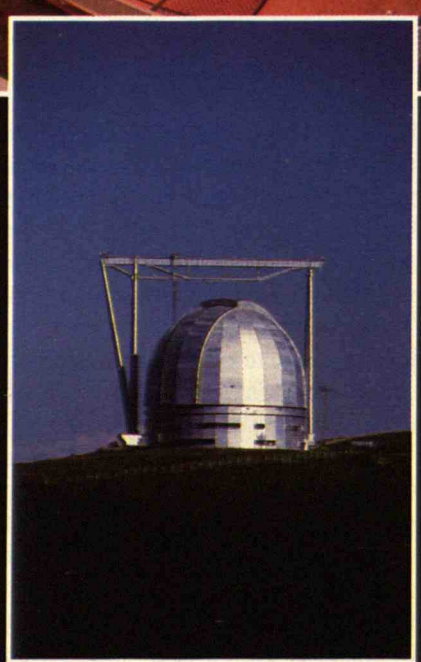
Why did the designers settle for third place? One reason is that the six mirrors were already in hand, left over from a U.S. Air Force project that never came to fruition. Another is that the design was highly experimental; if it worked, it could always be scaled up later.

Combining the light from multiple telescopes was not a new idea. Sketches for such designs had been around since the early 1930s, but it was only with the advent of digital computers that they became feasible. In particular, keeping six telescopes aligned to the high precision required was not practical by mechanical means alone. The many-ton structures that hold telescope optics and aim them at any point in the heavens bend appreciably as they tilt from zenith to horizon. Instead of trying to keep the massive objective mirrors aligned as they moved, the designers of the MMT turned their attention to the telescope's secondary mirrors. (A secondary mirror, used in all large reflector telescopes, is a small, usually convex mirror positioned in front of the primary mirror; it reflects light back to the telescope's focus through a hole in the primary.) In the MMT, the secondary mirror of each 1.8-meter telescope is "active"—that is, its angle is controlled by computer, keeping all six telescope images aligned at any elevation.

The MMT broke new ground in other ways as well.

PHOTOS ABOVE: ROGER RESSMEYER; CALTECH AND PALOMAR OBSERVATORIES





THE RUSSIAN 6-METER TELESCOPE, WHICH DWARFS THE RED-JACKETED FIGURE STANDING AT ITS BASE, IS AN IMPRESSIVE ENGINEERING FEAT, BUT ITS MASSIVE 42-TON MIRROR HEATS OR COOLS THE AIR AROUND IT, CAUSING IMAGES TO BLUR.

To minimize thermal inertia, for example, the mirrors are largely hollow, weighing 1,200 pounds each—only a third of what they would weigh if they were solid. Similar to corrugated cardboard, they consist of a glass grid sandwiched between two glass plates. Another innovation is the MMT's mounting. Conventional telescopes swing in a huge arc as they track stars across the sky, requiring complicated bearings and expensive, cathedral-like buildings. But the MMT is mounted like a naval gun: it tilts straight up and down, and the entire building—which is a fraction of the customary size—rotates to provide horizontal motion.

All these departures from conventional telescopes proved so successful that the MMT became the catalyst for a new wave of technical experimentation and innovation unprecedented in the history of telescope design. In 1979, a consortium of European astronomers initiated plans for a new 3.5-meter telescope at the European Southern Observatory in La Silla, Chile. The New Technology Telescope (NTT), recently completed, incorporates several features of the MMT, notably the gun-style mount, the rotating building, and the use of active optics. It was in the latter technology, however, that the NTT pioneered the path that European telescopes will follow into the next century.

While the active optics of the MMT are confined to the secondary mirrors, the NTT provides computer control of the shape of its primary mirror. This was achieved by making a mirror so flexible that it could be deformed by its support system, an array of 78 pistons on which the mirror rests. To this end, the mirror is extraordinarily thin: its "aspect ratio," or ratio of diameter to thickness, is 15:1, instead of the more usual 8:1 for mirrors in most of the world's 4-meter-class telescopes. Unlike conventional mirrors, which are con-

cave on one side and flat on the other, the NTT mirror is concave on one side and convex on the other, like a contact lens—a shape known as a meniscus. This shape allows the mirror to be uniformly thin and flexible.

The main purpose of the NTT's piston-and-mirror apparatus is to correct for warping caused by the force of gravity as the telescope goes through its motions. But such control opens the possibility of compensating for the kinds of errors that can be introduced when a "perfect" mirror is installed in a telescope support system different from the one used in the optics shop. This approach could also compensate for any errors introduced during the polishing of the primary, an advantage from which, to point to a notorious example, the Hubble Space Telescope could have benefited enormously.

"First-light" NTT tests in 1989 proved the effectiveness of the meniscus mirror beyond a doubt. Images 0.33 arcsecond in diameter—a quality rarely achieved with most telescopes—soon appeared on bulletin boards of major observatories throughout the world. The NTT is now fully operational and continues to perform extremely well.

**The success of large telescopes pieced together from small optical elements has not dampened astronomers' appetite for bigger single mirrors.**

Another radical approach to mirror design is embodied in the Keck telescope, built at one of the premier sites in the Northern Hemisphere—atop Mauna Kea, a 14,000-foot extinct volcano on the island of Hawaii. In the late 1970s, as the MMT was nearing completion, astronomers at the University of California at Berkeley were looking for a different way to achieve a large aperture by combining the light from smaller ones. Rather than linking several telescopes, as the MMT was in the process of doing, they proposed to assemble a single giant mirror from smaller segments fitted together like a jigsaw puzzle. This segmented mirror approach was much more complicated than the multiple mirror one. Its complexity lay both in producing the mirror segments themselves and in assembling them in a structure where adjacent segments would stay aligned to millionth-of-an-inch optical tolerances as the telescope was aimed about the sky—no mean feat. The designers targeted a 10-meter aperture, the next step in the geometrical progression begun by the 2.5-meter Hooker telescope and continued by the 5-meter Hale.

What this design possessed in ingenuity and audacity it lacked in financial support. It wasn't until 1985 that the project took serious flight, when the W.M. Keck Foundation, established by a California oil magnate, made a $70 million grant. Even then, the Keck designers had to overcome enormous technical hurdles to assemble a collection of 1.8-meter hexagonal segments—36 in all—into a coherent and seamless whole.

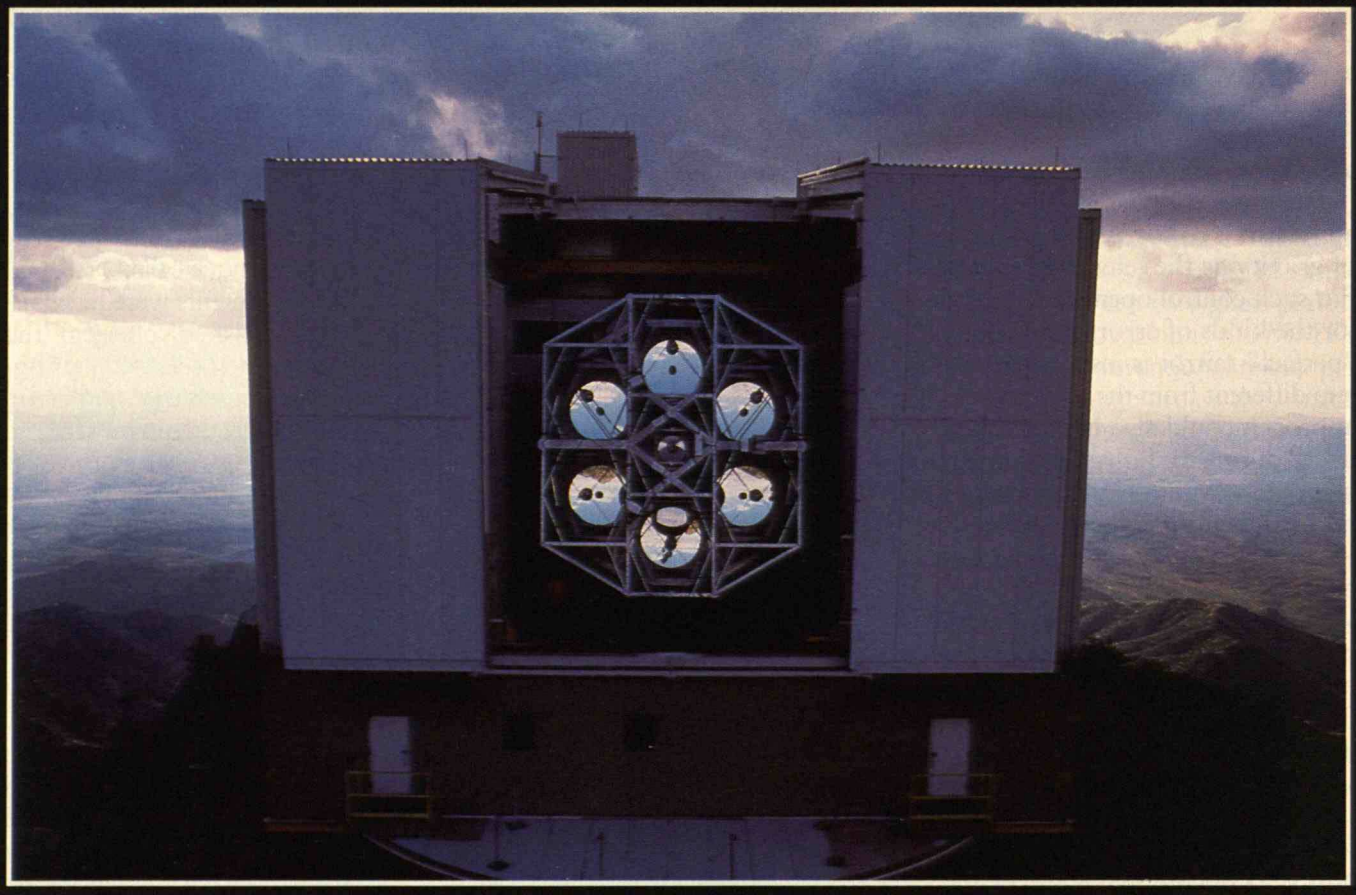
The designers had settled on a hyperboloid shape for the surface of the mirror. As a result, each ring of segments would have to be polished to a different curvature appropriate for its particular position in the mirror. Such off-center polishing is devilishly hard, so the Keck designers had to find a new way to mass-produce the segments. They invented a technique called "stressed mirror polishing," in which the segments were mechanically stressed with harnesses, polished spherical (the easiest surface to produce), and then released, springing into the desired shape. After much trial and error, the finished surfaces were still slightly off. So most of the segments were installed in the telescope with "warping harnesses" to force their surfaces to the proper curvature. The rest were polished by a new technique called ion-figuring, where the surface is bombarded with high-velocity argon ions that remove the glass one molecule at a time.

Maintaining the alignment of the segments in the telescope was an even thornier problem. The solution was a system of 168 sensors—two on each edge of each segment—that detect a displacement of any segment with respect to its neighbors to an accuracy of 0.001 micron. Twice a second, a computer sends error signals to hydraulic screw-driven actuators, which make subtle adjustments to align each segment with its neighbors. In this way, the mirror keeps its curvature with extraordinary precision.

First light has, appropriately, occurred in stages. In December 1990, with the first 9 segments installed (already giving the Keck the same collecting area as the Hale telescope), the control loop was closed for the first time. The entire system worked, producing images of 0.6 arcsecond—a remarkable achievement for the first try with such a complex instrument. By April 1992, all 36 segments had been installed. A year later, first light of the completed Keck was achieved when an infrared camera recorded the most distant known galaxy, yielding the most detailed infrared image ever made of an object at that distance. *(See the sidebar "Seeing the Light" on page 62.)*

The early results have been so impressive that the Keck Foundation has provided a grant to build a second, identical telescope atop Mauna Kea, 85 meters from the first. One benefit of such twin telescopes is that they will be able to share multimillion-dollar laboratory equipment. Perhaps more important, techniques are being developed in a field known as optical interferometry that may someday allow the light from separate telescopes to be combined in surprisingly powerful ways. By sampling incoming light at two or more dif-

PHOTOS: ROGER RESSMEYER



THE MULTIPLE MIRROR TELESCOPE IN ARIZONA—WITH ITS SIX 1.8-METER MIRRORS YOKED TOGETHER UNDER COMPUTER CONTROL, AND ITS NOVEL MOUNTING AND ENCLOSURE—SET OFF THE WAVE OF TELESCOPE INNOVATION THAT BEGAN IN THE 1970S.

ferent vantage points, it is theoretically possible to simulate the resolution of a single gigantic telescope—an instrument whose diameter equals the distance between the outer edges of the farthest-spaced mirrors. Thus, unless this embryonic technology runs into major problems, the twin Kecks may eventually offer the resolution of a telescope 100 meters across.

### The Allure of Large Mirrors

The coupling of separate telescopes in this fashion is probably decades off, but other innovations under way at this moment promise to bear fruit within a few years, or at least early in the next century. One hotbed of activity is the development of more sophisticated techniques for casting and polishing mirrors.

Surprisingly, the success of instruments like the Multiple Mirror Telescope and the Keck, which have proved that a large aperture can be built up from small optical elements, has not dampened astronomers' appetite for bigger and bigger single mirrors. This is partly because of the seductiveness of producing a mirror—the heart and soul of the machine—larger than ever. But greater size will also permit the building of new and larger MMTs using huge mirrors as the components.

Of course, circumventing the barriers of weight, time, and cost previously imposed by large mirrors requires considerable ingenuity. In the early 1980s, a group of astronomers and engineers at the University of Arizona set themselves the remarkable goal of producing 8-meter mirrors within a decade. In the intervening years, a giant mirror factory has appeared under the school's football stadium, producing progressively larger blanks—the unpolished disks that become mirrors. While these blanks are rigid enough to withstand the force of gravity, they are proportionally lighter even than the "sandwich" mirrors of the MMT. The secret is in their unique construction: two thin faceplates and the honeycomb-shaped grid that lies between them are cast as a single piece of glass. This makes them much stronger than the MMT mirrors, in which separate glass parts were fused together.



PHOTO: MMT OBSERVATORY

The Arizona process also bypasses one of the most laborious steps of mirror making—that of rough-grinding the surface of the blank to render it concave. Ordinarily, glass is removed with a large disk that rubs a slurry of ever-finer grits on the surface of the mirror blank. This must be done slowly to avoid damaging the blank, and must be accompanied by delicate and time-consuming optical tests of the ground surface. For the 5-meter Hale mirror, this process took 21 opticians two years, during which they removed five tons of glass.

In the new approach, known as spin casting, glass is heated to the melting point, flows to fill its mold, and is spun in a huge rotating oven at the proper speed to bring the mirror's front surface to within a millimeter of its final curvature.

The University of Arizona team has pioneered a new approach to the final polishing stage as well. The classic techniques used since Sir Isaac Newton's time require a level of crafting, feel, and intuition that has made legends of the opticians who have polished the great mirrors of this century. These methods are also labor-intensive: the Hale opticians required another two years to polish the 5-meter mirror. By replacing intuition with sophisticated electronics, the Arizona approach does the same job with a fraction of the labor. This technique, which has already been used to polish one 1.8-meter and three 3.5-meter mirrors to tolerances comparable to the best produced by any other method, proceeds as follows: A polishing tool whose shape can be changed under computer control 1,000 times per second inches its way across the surface of the mirror. At each point on its journey, the tool is mechanically deformed to produce the desired finished shape of the portion of the mirror directly beneath it.

The goal of making 8-meter mirrors through these techniques is close to being reached. In 1992, the largest mirror blank ever produced in the United States emerged successfully from the oven. It is 6.5 meters in diameter but weighs only 10 tons—a quarter as much as a solid mirror of the same diameter. In the months ahead, a second 6.5-meter mirror will be cast.

In 1996 one of these mirrors will replace the six smaller ones in the MMT, more than doubling its light-gathering power. The other is intended for a telescope being built by the Carnegie Institution in Las Campanas, Chile. It is possible that a third 6.5-meter mirror will be made before the the process is scaled up to produce a pair of 8.4-meter mirrors. These twin giants will be incorporated into the Large Binocular Telescope, an instrument being built by the University of Arizona in collaboration with Italy's Arcetri Astrophysical Observatory and possibly other partners. Groundbreaking for this dual-mirror telescope has already begun atop Arizona's Mt. Graham, and first light is expected within about five years.

In parallel with the efforts in this country to produce larger telescope mirrors through spin casting and honeycomb structure, European astronomers, encouraged by the success of the NTT, have continued to explore and refine meniscus mirror technology. Most recently, Schott Glaswerke of Mainz, Germany, completed the first of four 8.2-meter blanks—the world's largest—destined for installation in the European Southern Observatory's Very Large Telescope at Paranal, a new site being developed in northern Chile. The first of these meniscus blanks, 24 tons in weight and an astonishing 177 millimeters thin (giving it an aspect ratio of 46:1), will undergo two years of polishing at a French optics firm before it is shipped to Chile.

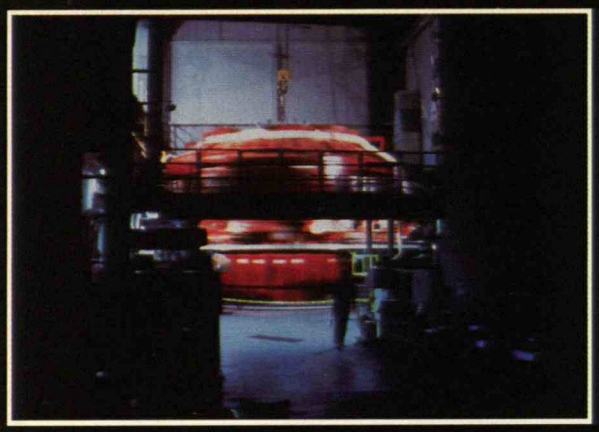
It may soon be possible to cancel out atmospheric distortion on the ground, boosting the image quality of large telescopes more than 10-fold.

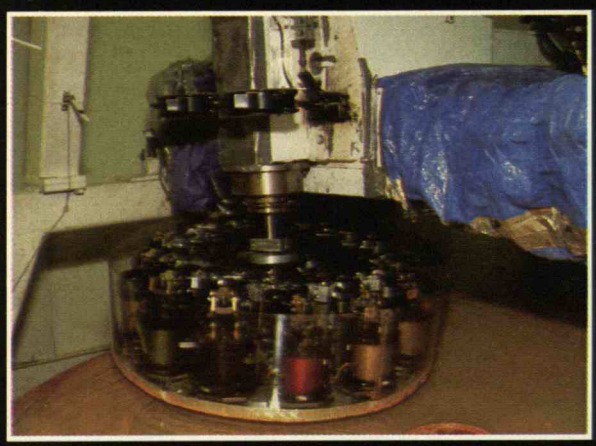
Unfortunately, the adoption of ever thinner meniscus mirrors pits telescope designers against yet another force of nature: wind. On an exposed mountaintop, it's hard enough to maintain precise curvatures with a rigid honeycomb mirror. But computer models of the effects of wind on a flexible membrane such as a meniscus mirror resemble nothing so much as a manta ray thrashing in a turbulent sea. The big challenge for builders of large meniscus-mirror telescopes will therefore be to develop computer-conrolled actuators that can adjust the shape of the mirror quickly enough to compensate for these rapidly varying forces.

### Sharper Images

Despite all the sophisticated technology that goes into maintaining the proper curvature and alignment of large mirrors, the use of active optics does nothing to obviate the image degradation caused by the ever-changing ocean of atmosphere through which the telescope must peer at the heavens. Although, in principle, a telescope's resolution is directly proportional to the diameter of its primary mirror, the detail with which images can be recorded remains limited to around 0.5 arcsecond, just as in Galileo's time.

The obvious solution is to use a space-based instrument. Yet NASA's Hubble telescope cost more to build than all the world's large telescopes combined, and its 2.5-meter miror has only one-tenth the power of the 8-meter telescopes under construction. Fortunately, it may soon be possible to cancel out atmospheric distortion on the ground, thereby boosting the image quality of large telescopes more than 10-fold.





NEW PRODUCTION TECHNIQUES CAN TAKE MUCH OF THE TOIL OUT OF MAKING LARGE MIRRORS. "SPIN CASTING" (TOP) REPLACES ROUGH GRINDING BY EXPLOITING THE CENTRIFUGAL FORCE OF A ROTATING FURNACE TO FORM A MIRROR. THE MIRROR IS THEN POLISHED WITH A TOOL THAT ADJUSTS ITS SURFACE TO IMPART THE DESIRED CURVATURE (BOTTOM).

In the late 1980s, a handful of observatory groups in both the United States and Europe began to explore the powerful technique of "adaptive optics," whereby the surface of a very flexible mirror is rapidly deformed to correct for distortion in the incoming light. This technology is neither simple nor inexpensive to develop, especially since the time intervals are measured in milliseconds and the motions of the mirror surface are measured in tens of microns. But research on applying adaptive optics to telescopes got a major boost in 1991. It was then that well-funded and highly advanced adaptive-optics efforts by two government agencies—the Strategic Defense Initiative Organization and the Defense Advanced Research Projects Agency—were declassified. Technical capabilities that might otherwise have taken astronomers decades to develop became available almost overnight.

The adaptive-optics approaches now being pursued are varied, but in essence involve creating a mirror of many segments, each of which can be tipped, tilted, and pistoned up and down 1,000 times a second. Fortunately, the mirror to be deformed need not be the primary; it can just as well be a smaller secondary mirror. The result will be like a tiny version of the Keck primary mirror capable of being adjusted 500 times faster.

The key to success will be accurate measurements of the distortion of the incoming light. The required precision can be achieved only if the light source is relatively bright. While stars would seem plentiful for the purpose, those bright enough to serve are available in only about 1 percent of the sky.

To surmount this serious limitation, astronomers are concentrating on producing bright artificial stars wherever the telescope is pointing. One promising approach is to use the telescope not only as a receiver but also as a transmitter to project a laser "beacon" into the sky. High in the earth's atmosphere is a layer of sodium atoms. Because the beacon emits light of a pure single color that matches the frequency at which sodium atoms resonate, the sodium layer scatters the light, forming a glowing spot 60 miles above the gound. Some of the light from this spot is scattered downward. At the focus of the telescope, this returning light is bright enough that the distortion it underwent in the atmosphere can be analyzed within a millisecond. Commands can then be sent to the pistons controlling the deformable mirror to reshape its surface accordingly.

Adaptive-optics experiments in astronomy are still in their infancy. It was only in April 1993 that light from a sodium beacon—installed on the MMT—was first successfully analyzed and used to generate correction signals. Reliable deformable mirrors must still be built and attached to complex computer-controlled actuators. And the many components of an adaptive optics system must be integrated and made user-friendly for routine observations.

Even at its most mature, adaptive optics will still have limitations. Correcting for distortions becomes increasingly difficult at shorter wavelengths of light, so most early efforts are being directed at the relatively long wavelengths of the near infrared, instead of the visible wavelengths more commonly studied. And even though the laser beacon moves and points in the same direction as the telescope, light from objects slightly off center from the beacon follow a different path through the atmosphere. Thus, not all features within the telescope's field of view can be corrected equally.

But imperfect as it is, adaptive optics promises to make the universe spring into focus as never before.



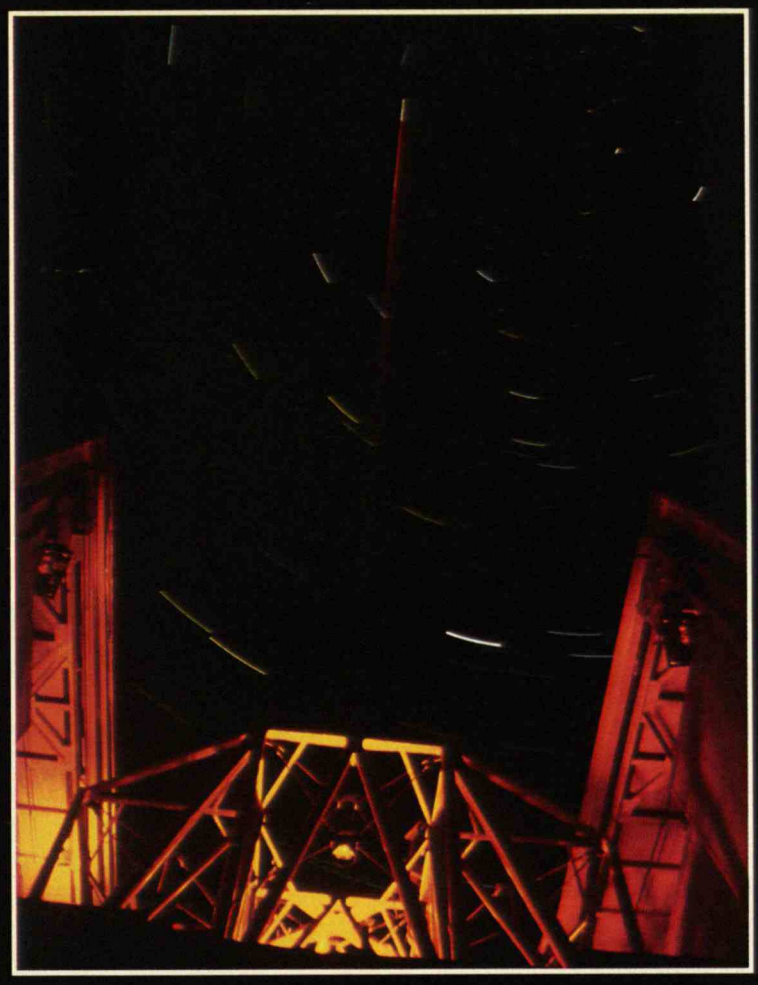
PHOTOS: LORI STYLES, UNIVERSITY OF ARIZONA

This technology is arguably the most important development for optical telescopes since their invention.

## What Is to Be Seen

The advances in telescopes during the last quarter of the twentieth century will provide astronomers with unprecedented observing power at the beginning of the twenty-first, and it is tempting to try to predict how, and with what results, this power will be applied. Such an exercise must carry the caveat that almost every previous attempt at prescience in astronomy has proved wrong. Most of the seminal discoveries of the past—the Jovian satellites, the expansion of the universe, quasars, microwave background radiation, and so on—have been serendipitous. The astro-prognosticator must therefore proceed at his or her peril.

One of the few certainties is that steady improvement in the faintness threshold provides the opportunity to push back dramatically the horizon beyond which we can study the overall structure of the universe. Galaxies now provide the primary marker for such studies. In recent years, astronomers have conducted "redshift surveys" of hundreds of galaxies—extensive studies of the speed and distance at which galaxies are receding from us as indicated by the degree to which their light is shifted toward the red end of the spectrum. Such surveys have yielded one of the most important results in observational cosmology: the first three-dimensional maps of the universe, out to a distance of about 300 million light-years. These maps, in turn, led to the discovery in 1986 that the distribution of matter in the universe is highly uneven—galaxies appear to cluster as if on the surface of otherwise empty "bubbles." Theorists have yet to satisfactorily explain the existence of such structures.



IN AN EARLY TEST OF ADAPTIVE OPTICS, THE MULTIPLE MIRROR TELESCOPE AIMS A LASER SKYWARD TO GAUGE THE EFFECTS OF ATMOSPHERIC DISTORTION. FULL-SCALE ADAPTIVE-OPTICS SYSTEMS WILL RELAY THIS INFORMATION TO A TELESCOPE MIRROR THAT CAN CHANGE SHAPE FAST ENOUGH TO COMPENSATE.

Redshift surveys have so far been able to probe only the "local" universe. Whether similar structures persist farther out remains an open question in cosmology, and it seems reasonable to hope that telescopes capable of probing ever deeper into the universe will provide answers. This hope is reinforced by recent developments in fiber optics. Right now, the redshift of galaxies can be measured only through a tedious, one-at-a-time process. But the new, larger telescopes will be able to use fibers to feed the light from hundreds of galaxies simultaneously to large spectrographs, expanding enormously the volume of space that can be studied.

Even with such advances, there will inevitably remain a faintness horizon beyond which galaxies can no longer be detected and hence cannot serve as markers for large-scale structures. Quasars, however, can be seen to several billion light-years, and redshift surveys of these objects should reveal structures at distances well beyond the local universe we have studied so far. Such efforts will be enhanced by larger telescopes that can detect quasars that are now too faint to see.

While the rapid expansion of our horizon results simply from a steady increase in light-gathering power, bet-

PHOTO: UNIVERSITY OF CHICAGO

ter image quality represents a quantum leap. If the promise of adaptive optics can be realized, telescopes will be able to resolve images down to a few hundredths of an arcsecond. Although the resulting discoveries are much more difficult to predict, they are potentially all the more exciting.

Improved resolution could provide a definitive answer to one of the most perplexing questions in modern astrophysics: the true source of the prodigious energy of quasars. The key would be to study relatively nearby bodies known as active galaxies, whose nuclei also emit enormous amounts of energy and are thought to be powered by an "engine" similar to that responsible for the more distant quasars. A favorite theory to explain the extraordinary output of active galaxies and the even greater output of quasars calls for a black hole buried in the nucleus of a galaxy. Matter from a solar system–sized disk of material radiates energy at high efficiency before disappearing into the black hole. This picture has been built up painstakingly from circumstantial evidence at all wavelengths—from x-rays, through optical and infrared light, to radio waves. Yet no telescope has ever had the angular resolution to image even the outer part of such an "accretion disk" in the nearest known active galaxy. At the resolutions being projected for the largest optical telescopes of the early twenty-first century, images of such disks should at last be possible.

Another large cosmological mystery that higher reso-

## Seeing the Light

ASTRONOMERS have been driven to build bigger and bigger telescopes largely for a single purpose: to study ever fainter sources. But the techniques they use to study such sources are widely varied, and are as much subject to technological change as the telescopes themselves.

The most obvious method is to obtain an image of the source. In the old days, this would have been done through the eye of the astronomer, but in modern times photographic and other recording techniques have been used exclusively. Although images of a celestial source can provide important information about its size and shape, and, to some extent, its spatial structure, they tell us little about its physics and chemistry.

The great advances in astrophysics over the last century and a half have come from studying the spectra of celestial sources. Light from a source is first spread out into its component colors by a prism or grating. This spectrum is then recorded—either photographically or, more recently, electronically—allowing astronomers to study in detail the distribution of the light among various wavelengths. Such analysis reveals information such as the source's temperature (bluish stars are hotter than reddish ones), chemical composition, and motion toward or away from the observer. It is through spectroscopy that we have built up the bulk of what we now know about the observed universe, and it is to this science that nearly 70 percent of the observation time on the world's largest telescopes is devoted.

Despite the dominance of spectroscopy, imaging techniques have recently made great strides. Until the late 1960s, the preferred recording medium for astronomical data was the photographic plate, which is at best only about 6 percent efficient in registering the light that strikes it. In the '60s and '70s, electronic light detectors—originally developed by the military for night vision—improved efficiency nearly threefold.

Advances in solid-state devices over the last decade have allowed astronomers to produce highly specialized detectors that are 80 to 90 percent efficient. Infrared-light detectors, for example, have expanded the wavelength range over which optical telescopes can be used. The young science of infrared astronomy has made it practical to study low-temperature physical processes—such as interstellar dust grains glowing at a few tens of degrees above absolute zero, and stars being born from clouds of gas and dust—of which we were largely ignorant a decade ago.

Solid-state detectors in the visible-light range allow astronomers to peer farther into space. In fact, today's largest telescopes equipped with the best modern detectors can record objects roughly 100 million times fainter than the faintest star that can be seen with the naked eye—two orders of magnitude fainter than was possible as recently as 15 years ago.■

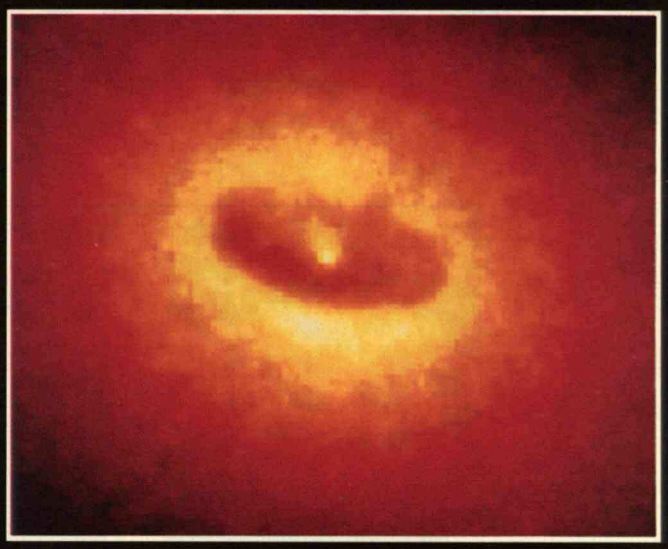
*—Frederic Chaffee*

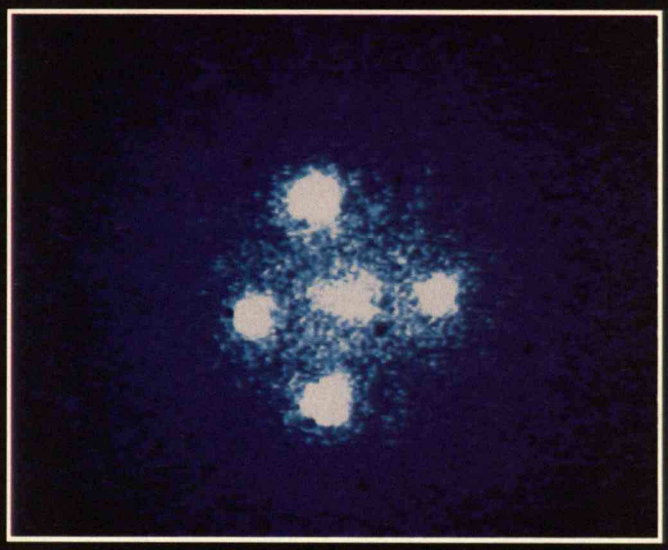
lution might clear up is the true value of the Hubble constant, or $H_0$. This constant, which relates a galaxy's distance to the speed at which it is receding, is fundamental to our estimate of the very scale of the observed universe. So far, determining $H_0$ has required a complex web of observations and inferential leaps that have absorbed the careers of many notable twentieth-century astronomers. Yet its value—and hence the size of the universe—remains uncertain to within a factor of two.

The serendipitous discovery in 1979 of a phenomenon called a gravitational lens provided the hope that $H_0$ could be measured directly, independent of the many assumptions required by all other methods. A gravitational lens is a mirage in which the light of a quasar is bent by the gravitational force of a galaxy or cluster of galaxies positioned between the quasar and the observer. The light may be bent in several directions at once, resulting in multiple images of a single quasar. If we could calculate the degree and direction of the bending, we ought to be able to determine how far away the foreground galaxy is from the background quasar. For the first time, we would know not only the relative distance between two celestial bodies (object *x* is 10 times closer than object *y*) but also the absolute distance in light-years. Astronomers could then nail down the Hubble constant once and for all.

At today's resolutions, the geometry of gravitational lenses is extremely difficult to study. But a large telescope with adaptive optics would be far better equipped to establish the size and shape of the foreground galaxy and the separation between quasar images. Although painstaking observations and measurements would be required, the payoff—determining the size of the universe, a Holy Grail of modern astronomy—would justify the effort.

Despite the vast potential of the new generation of telescopes, we should not expect instant miracles. Any major telescope requires years of debugging and experience to reach its full capabilities. The most important discoveries made with the Hooker and Hale telescopes took place many years after they first went into operation. The greater complexity of instruments like the MMT, the NTT, and the Keck only lengthens this learning process. More important, technology alone does not ensure breakthroughs: it is up to human imagination and creativity to produce those, and the whys and wherefores of the human spirit will always remain a splendid mystery. The safest forecast would seem to be that when we look back in a quarter-century on any predictions we now put forth, we will be both amused by their naïveté and awed by the discoveries that have actually been made. ■

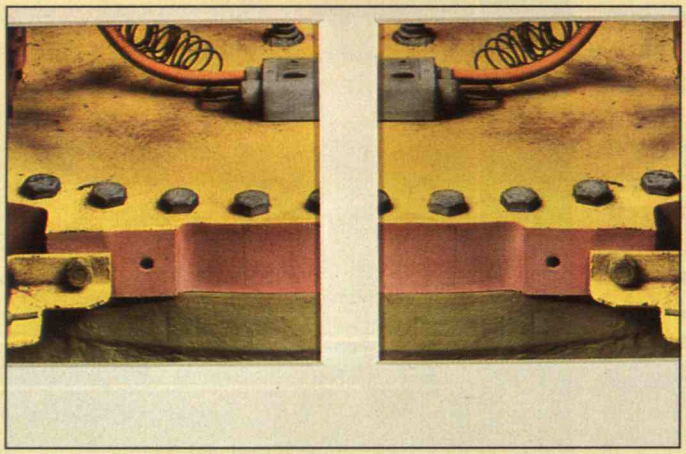


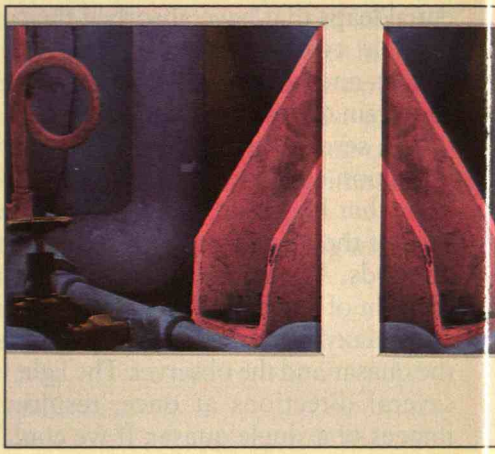


IMAGES FROM THE HUBBLE SPACE TELESCOPE OFFER GLIMPSES OF OBJECTS THAT, IF STUDIED AT HIGHER RESOLUTIONS, COULD HELP ASTRONOMERS CLEAR UP LONG-STANDING MYSTERIES. THE RING-SHAPED CORE OF AN "ACTIVE GALAXY" IS BELIEVED TO HARBOR A HIGH-ENERGY DISK OF MATTER THAT COULD PROVIDE CLUES TO HOW QUASARS WORK. A GRAVITATIONAL LENS—A MIRAGE FORMED WHEN A FOREGROUND GALAXY CREATES MULTIPLE IMAGES OF A BACKGROUND QUASAR—MAY HOLD THE KEY TO THE TRUE SIZE OF THE UNIVERSE.

PHOTOS: NASA

# ENCOUNTERING

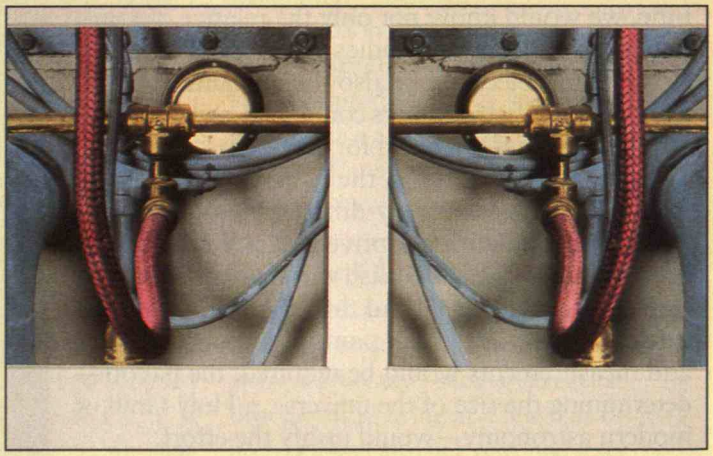




*When the editors and designers at* Technology Review *decided to hold a photography contest, we hoped that its title—"Encountering the Machine"—would elicit pictures of some of the seemingly infinite ways people can interact with technology.*

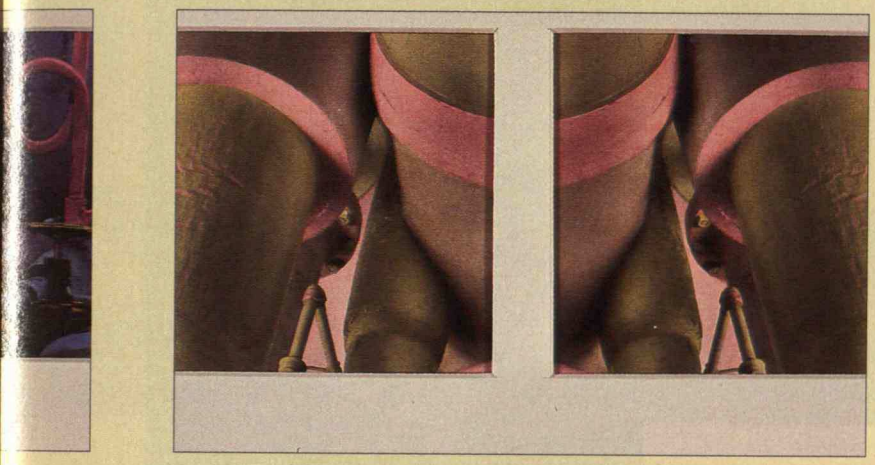
*And indeed, the images we received depicted everything from a prone breast-cancer patient staring solemnly up at medical equipment to young children examining a soldier's gun with awe. Interestingly, more than half the submitted photos concerned not high technologies but older ones, a "refreshing" surprise, according to contest juror Woodie Flowers, School of Engineering professor of teaching innovation at MIT. Overall, the contest showed that "technology is a local phenomenon," he said, not reserved for experts' eyes alone.*

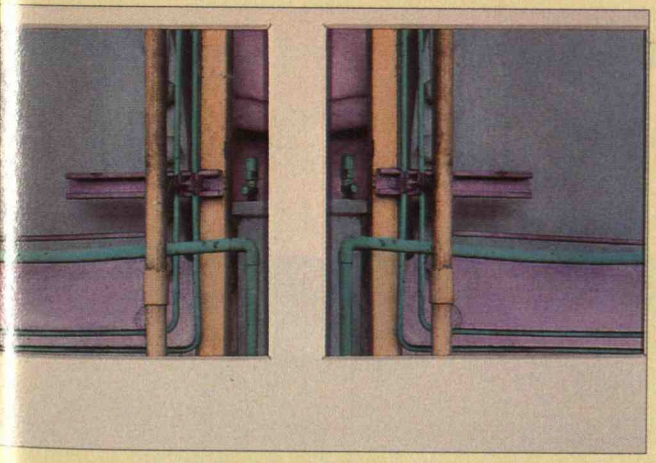
*In choosing the following winning entries, the judges—Sheri I. Blaney, president of the Picture Cube stock-photo agency in Boston; John P. Jacob, director of exhibitions at the Photographic Resource Center at Boston University; Katy Kline, director of the MIT List Visual Arts Center; and Flowers—mulled over hundreds of images. We are grateful to everyone who participated.*

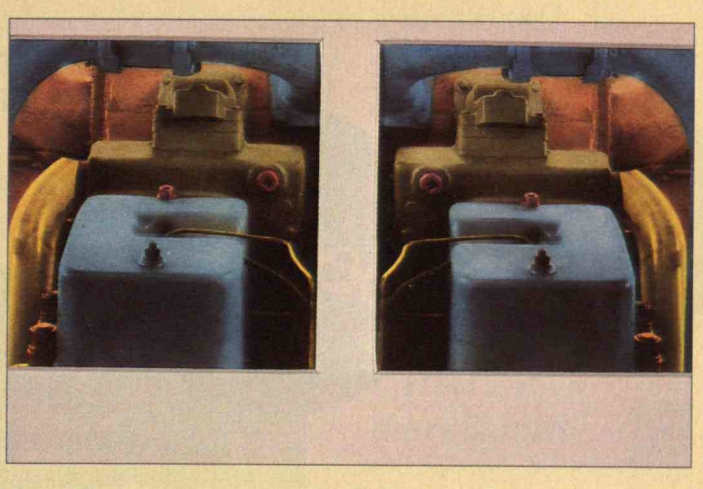


# THE MACHINE

1993 PHOTO CONTEST WINNERS





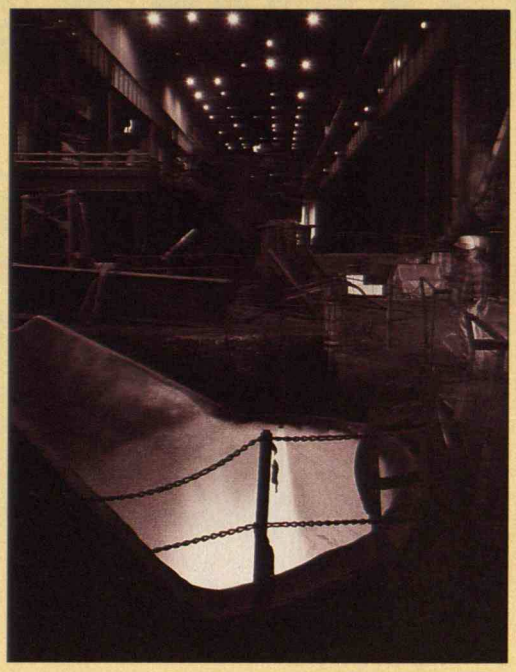


## FIRST PRIZE

*Maria Muller*

First

*The judges awarded first prize to Maria Muller of Arlington, Mass., who photographed equipment in a utilities plant that produces steam and chilled water. She manipulated her series of images by adding color and mirroring them. Muller "isolated inherently aesthetic elements of machinery and transformed them into images of sheer beauty," juror Jacob said. While almost all the other entries concerned a "photographer's documentation of how other people interact with technology," he added, Muller's work reflected her own engagement with technology. Muller used a Nikon 35 mm camera with Kodak black-and-white infrared film, then applied photographic oil paint.*



## SECOND PRIZE

### *Joseph Elliott*


*Second prize goes to Joseph Elliott, an associate professor of art at Muhlenberg College in Allentown, Pa., for a set of photographs taken in two shops of the original Bethlehem Steel Corp. plant, which over the next few years are scheduled to close. The judges admired the photographs' execution and their depiction of how, as Flowers said, "humans are still dealing with fire" as a technological process. With sponsorship from Hughmoore Historical Park and Museums, Elliot used a Horseman 4x5 inch view camera with Kodak T-Max 400 film.*


Third

## THIRD PRIZE

*Harry Bartlett*

*Harry Bartlett of Somerville, Mass., wins third prize for a photo in which people have become so much a part of computer technology that, as judge Kline said, one person appears to be "dematerializing." Bartlett used a Nikon F3 35 mm camera with Agfa 1000 film.*

Honorable Mention

## HONORABLE MENTION

### *Jean Lannen*

*Honorable mention goes to Jean Lannen of Pacifica, Calif., for a portrait of her nephew hammering in a garage under construction. The judges noted the photographer's recognition of a child rediscovering a fundamental technological process. Lannen used a Nikon FM 35 mm camera with Tri-X 1600 film.*

Honorable Mention

## HONORABLE MENTION

### *Vincenzo Pietropaolo*

*Vincenzo Pietropaolo of Toronto also receives an honorable mention for his photograph of a man carrying a gear. While in much of the image "wheels are carrying people, here a person is returning the favor," Flowers pointed out. Pietropaolo used a Leica M4-2 35 mm camera with Ilford HP5 film.*

# A Strategy for the National Labs

IN 1992 the giant Department of Energy laboratories such as Los Alamos, Lawrence Livermore, Oak Ridge, and Sandia collectively employed more than 50,000 people, including more than 20,000 scientists, engineers, and technicians, and consumed more than $6 billion—close to 10 percent of the total federal R&D budget. These labs are operated by private institutions under contract to DOE; along with similar Department of Defense facilities, such as MIT's Lincoln Laboratory, they boast unparalleled scientific and engineering capabilities and unique facilities. For some of them, especially those known as the weapons labs, the end of the Cold War has greatly diminished their primary mission: the research, development, and testing of military systems. What should these magnificently endowed labs do now?

Extensive defense research will continue to be essential, of course; we live in a chaotic world with new kinds of military threats. But clearly, the nation would be well served by a reallocation of resources from defense to civilian technology. The labs have seen the writing on the wall, and, with the support of Congress and the executive-branch agencies, are seeking to justify their existence at present budgetary levels by applying their resources to R&D on a variety of pressing national issues. Los Alamos, for example, has become a major player in the Human Genome Project, and Lawrence Livermore is conducting some of the leading research on global climate change and other environmental problems.

The labs have also sought to make their technological capabilities available to industry through hundreds of cooperative research and development agreements, or CRADAs, in which the federal government matches industry funding in fields ranging from textiles to semiconductors. The Department of Energy alone is now supporting CRADAs to the tune of about $200 million annually; in most cases, the research has little direct bearing on the mission of that agency. The recently announced cooperative effort between the national labs and the Big Three U.S. carmakers to develop a clean, efficient automobile signals the strong push to relate the labs' work to the civilian economy.

But CRADAs are only a first step. As a possible long-term goal, we might seek to gradually wean that part of a lab not needed to support its parent agency from government support. The privatized institution thus created would offer its formidable R&D services in the open market, drawing its clientele from industry and from a range of government agencies. Separation and privatization over a period of 5 to 10 years, with steadily reduced government funding, would permit the new institution to find its way in the alien territory of the commercial contract-research business.

Consider the approach taken by General Electric in the late 1980s when it bought RCA. For five years, GE funded RCA's Sarnoff Research Laboratories as the Stanford Research Institute took on responsibility for it. The U.S. government would similarly provide bridging money to the new private laboratories. (The federal government has nurtured such transformations in the past; Rand Corp. and MITRE, once funded exclusively from the federal R&D budget, now perform diverse R&D for a variety of public- and private-sector clients.)

The national labs would find the conversion to the private sector difficult; they are, if anything, even less accustomed to market competition than is the private defense industry. Moreover, this shift might well meet political opposition. The national labs have become significant employers in their home states. The Department of Energy's Sandia and Los Alamos labs, for example, are among New Mexico's largest employers and account, directly or indirectly, for 10 percent of the state's jobs.

But it matters not to politicians whether the laboratories are working on nuclear weapons, energy, or environmental problems—as long as they are working and as long as the financial, physical, and human resources of these laboratories remain in their present locations. With their new freedom to pursue research in whatever areas the market demands—rather than just fulfilling government missions—these laboratories might, if successful, spawn spin-off companies and attract new businesses at a far greater rate than they do today. This speculation is not unfounded; research universities and private R&D companies with less governmental direction of their activities tend to contribute significantly to their region's economies.

Congress is considering at least six different bills that attempt to chart the future of the national laboratories. All these proposals aim, in one way or another, to convert the labs to civilian purposes. These are half-measures, however; the labs would continue to depend overwhelmingly on federal funding. Privatization is a bolder step that has yet to reach the policy stage.■

*ROBERT M. WHITE is president of the National Academy of Engineering.*

PHOTO: CLAUDE VAZQUEZ

# Cyberpornography

It is no surprise to see the avant-garde falling head over heels in love with new technology. As early as 1910, a group of self-consciously modern Italian artists, the "futurists," proclaimed that the salvation of humankind lay in the speed and shiny metal of automobiles, airplanes, and industrial factories. Today, this well-worn conceit receives slick retread with the coming of cyberculture, a movement that links developments in R&D labs with the latest wrinkles in pop fashion. Leading the parade are three eye-catching magazines recently launched in the San Francisco Bay area. Together they suggest what the rising tide of future hype promises to wash ashore.

Most prominent of the group is *Wired*, a techie publication focusing on the world-transforming power of computers and telecommunications. Its pages are filled with news stories, interviews, and editorials praising interactive media, virtual reality, cinematic special effects, and hacker high jinx. Cybercult heroes such as sci-fi guru William Gibson and info-libertarian George Gilder issue lofty pronouncements to inspire the flock. Each new laboratory development is predicted to become an essential piece of people's lives in the new millennium. The writers in these magazines project a nervously "wired" world in which all individuals and institutions become nodules within global information systems.

A somewhat different take on the same themes animates *Mondo 2000*, the would-be *Vogue* of cybercult style. Along with news about trendy applications of electronic media, this magazine offers features on cyberpunk novels, performance artists, hip-hop music, brain implants, artificial life, and nanotechnology. Affecting an upscale Bohemian manner, *Mondo 2000* is less concerned with hardware and software than with anticipating how fashion-hungry youth will respond to the new gadgets in haircuts and hemlines.

Despite their differences, *Wired* and *Mondo 2000* display a remarkable similarity in mood and presentation. Surrealistic images in dayglow colors telegraph an edge of excitement. On every page, a jumbled mix of typefaces and sizes makes sure the eye cannot rest. In both, the preferred prose style is panting hyperbole—often focused on predictions that the human body and electronic devices will merge in ecstatic unity. As a *Wired* article on "neurohackers" exclaims: "Hardwiring of neural prostheses is already here and will continue to develop toward completely implantable systems controlled by the user's brain."

The logical extension of this throbbing enthusiasm appears in *Future Sex*, a publication devoted to the kinky side of the digital age. Its mission is to exhibit a rich smorgasbord of techno-erotic alternatives for bored, middle-class Americans: gender-bending sensuality, designer drugs, and electronically enhanced pleasures of every description. Interspersed among its articles are advertisements for 900-number telephone sex, new X-rated CD-ROMs, and endless varieties of hard core for your hard drive. I was interested to learn, for example, that the "data gloves" used in virtual-reality experiments to give participants a hands-on feel for computer-simulated worlds are now being tailored for other human organs as well. In the vision of the magazine's editor, Lisa Palac, tomorrow's sex will be androgynous, promiscuous, hungry for excess, and technologically mediated to achieve peak moments of "cyborgasm."

So this is progress. Not long ago, seedy erotica was confined to run-down, dimly lit city neighborhoods. The coming of the VCR, of course, has brought hundreds of X-rated titles to the neighborhood video store, spawning a multibillion-dollar growth industry that has altered the moral norms of the American middle class. Now the expanding cyberculture promises a veritable supermarket of high-definition, digital, interactive titillation, as Silicon Valley and a revitalized smut industry forge lucrative new bonds.

Is *Future Sex* merely an aberration, an attempt to stretch the ideas of cyberculture to uncharacteristic extremes? I don't think so. In fact, its underlying message is essentially similar to that of the other two new publications. All of them pander, bombarding their readers with pure sensation for sensation's sake—a good working definition of pornography.

What makes these magazines at once fascinating and appalling is their blasé amorality. One might suppose that the arrival of these powerful technologies for transforming human experience would be an occasion to ponder serious choices and select fruitful possibilities, as distinct from hideous degradations. But in today's cybercult thinking, outcomes are announced, not debated. The future pours forth with raw inevitability. For those in the middle of a cyborgasm, there is evidently little need to think. ■

PHOTO: L. BARRY HETHERINGTON

*LANGDON WINNER teaches science and technology studies at Rensselaer Polytechnic Institute. He is the editor of* Democracy in a Technological Society *(Kluwer, 1992).*

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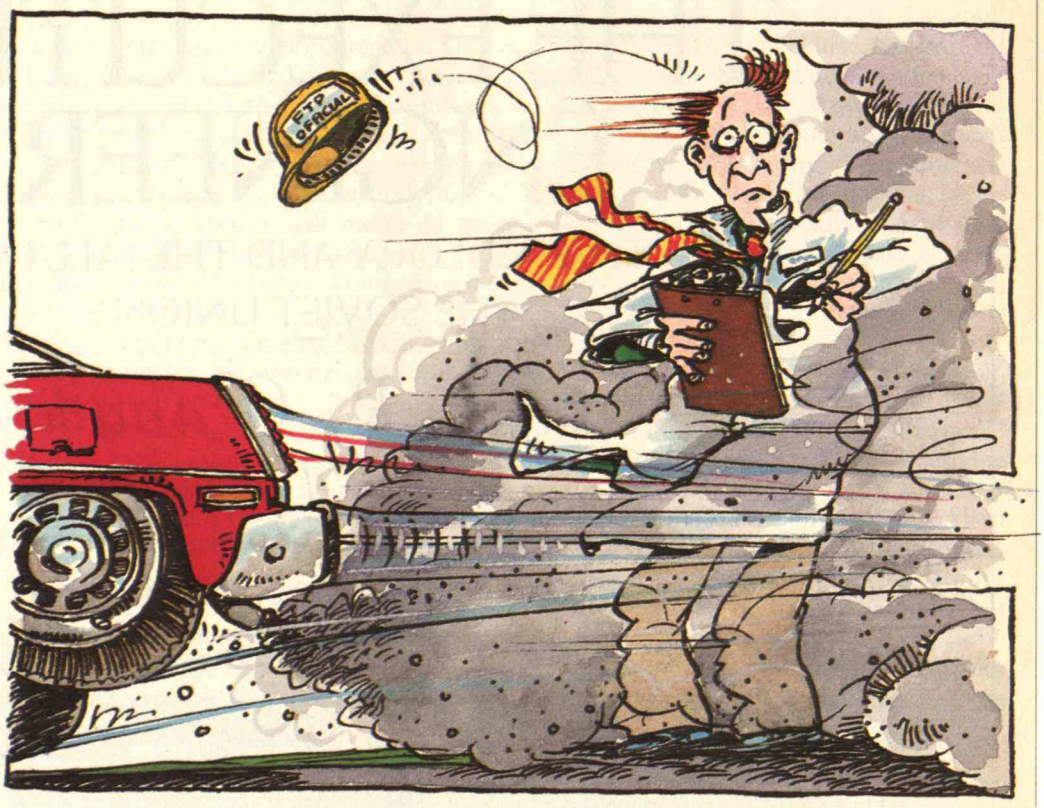
FORUM

MARC ROSS

# Why Cars Aren't as Clean as We Think




REGULATIONS have supposedly made cars a lot cleaner in the last 25 years. Emissions of carbon monoxide and hydrocarbons are nominally a mere 4 percent of their late-1960s levels. But emissions are actually 5 to 10 times higher than currently "permitted" levels. Why is there such a disparity—and what does it imply for policymakers?

One well-known problem is the number of old cars still on the road, manufactured under less stringent standards, but this problem is exaggerated. Some 10 percent of more recently built cars have developed engine or exhaust system malfunctions; this is believed to be the largest source of excess emissions. To address this, carmakers could identify types of malfunction and redesign new vehicles to reduce the likelihood that they occur. But there is another significant and little recognized source of the discrepancy: the official method of measuring automotive emissions is grossly misleading.

In the Federal Test Procedure (FTP), stationary vehicles are driven on rollers under laboratory conditions, following a prescribed second-by-second sequence of speeds intended to simulate a typical urban driving cycle. The exhaust is collected and chemically analyzed. But the FTP driving cycle virtually ignores the episodes of driving that contribute disproportionately to overall emissions: the bursts of high power needed to climb hills and accelerate at high speeds.

The heart of the emissions-control system in today's vehicles is a catalytic converter in the exhaust line. For the catalyst to be effective, the fuel-air mixture delivered to the engine must have the chemically correct ratio; that way, the catalyst can work on exhaust that has balanced residues of partially burned fuel and oxygen. To maintain this chemical balance, an oxygen sensor is installed in the exhaust line, and its signal is used to adjust the mix of fuel and air entering the engine.

But when high power is called for, today's vehicles override this sensor and inject excess fuel into the cylinders—typically 20–30 percent more than what is needed to chemically balance the oxygen present. This excess fuel raises by orders of magnitude the emission rate of carbon monoxide and hydrocarbons; each second of driving with the pedal down corresponds roughly to 30 *minutes* of carbon monoxide emissions, and 1 minute of hydrocarbon emissions in the moderate driving represented by the FTP test. And such high-power episodes are not rare. Drivers of small cars, in particular, often find themselves keeping up with expressway traffic, or climbing hills, by driving for long stretches at wide-open throttle.

The design that relies on excess fuel for high-power operation is a vestige of the days of carburetor engines, which required the rich mixture to avoid engine hesitation. With simple changes in engine design, cars could probably achieve high power much more cleanly. European manufacturers have taken a step in this direction; in some new Volvos, for example, high-power emissions are one-third to one-half lower than in most other cars. Modifying the software that controls the air-fuel mix enables these cars to enrich the fuel much less than U.S. cars do, or for a briefer period.

*We can't make sensible regulations unless we know what the problem is.*

With rare exceptions, U.S. automakers appear not to have seriously studied such approaches, much less implemented them. Of course, government



ILLUSTRATION: JON McINTOSH

regulators could encourage such design changes by amending the FTP so that it accounted for high-power driving. Carmakers would then be free to devise their own engineering solutions, as long as they met emission standards under truer tests.

Unfortunately, some regulators in the United States seem not to understand the problem. California, New York, and a few other states are simply lowering the permissible emissions for cars on the standard FTP cycle. The federal government plans to do the same by 2003. Although well-intentioned, this is bad policymaking, because most of the automotive emissions are not related to those measured in the FTP.

The irrelevance of today's FTP reflects a failure—by government, university, and auto industry labs—to adequately study the fundamentals of automotive emissions. Considering the importance of vehicle emissions and the billions of dollars in control costs borne by vehicle manufacturers and buyers, this neglect is mind-boggling.

Sorting out the physical sources of excess emissions, such as high-power operation, will also allow us to more rationally focus transportation R&D. Ultimately, we will develop alternatives to the internal combustion engine, such as vehicles powered by batteries, fuel cells, or some hybrid of a gasoline engine and electrical energy storage. Large subsidies would be needed to accelerate the introduction of any of the new technologies, because they will, at least initially, cost more and perform worse than what we already have.

But we might vastly and quickly improve what we already have. Addressing the problem of high-power emissions and malfunctioning vehicles could reduce emissions of conventional automobiles by 80 percent or more. That represents a target too fat to ignore.■

*MARC ROSS, a professor of physics at the University of Michigan, is on the executive committee of the Washington-based American Council for an Energy-Efficient Economy, an independent environmental organization.*

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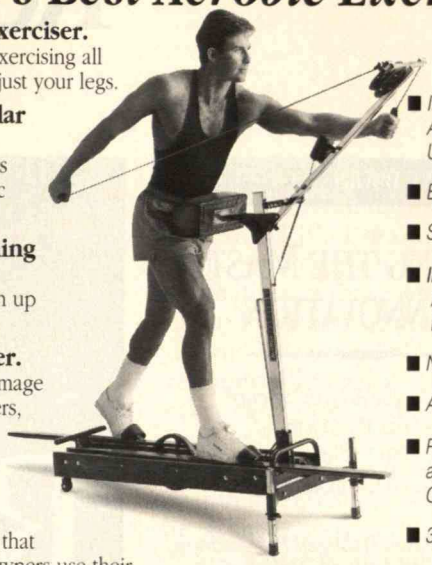

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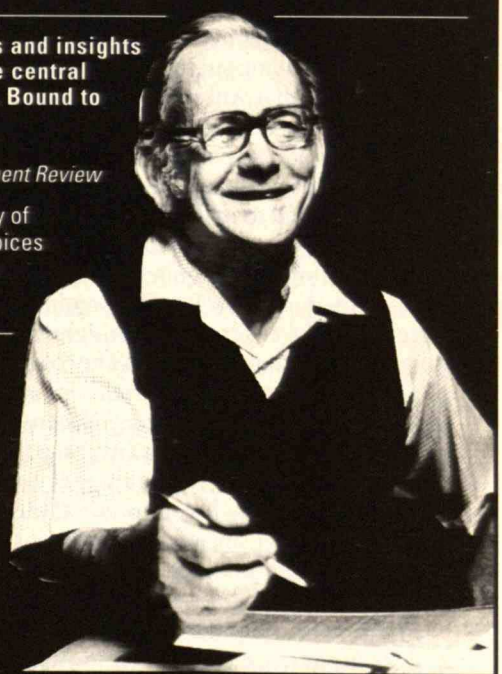

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# Reviews

BOOKS

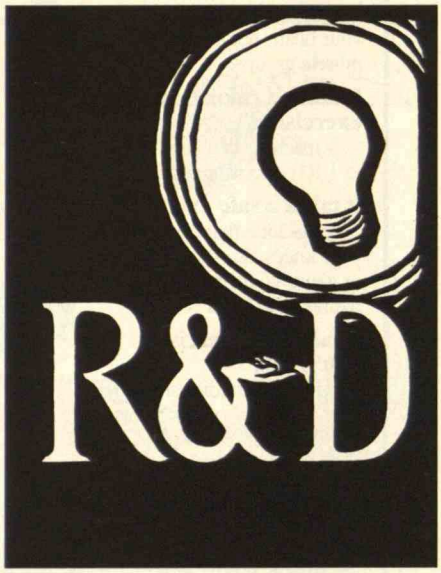
## REVISITING THE MASTER OF INNOVATION

*Inventivity: The Art and Science of Research Management*
by John J. Gilman
Van Nostrand Reinhold, $29.95

*Learning to Manage Technical Professionals: Crossing the Swamp*
by Richard J. Stein
Addison-Wesley Publishing Co., $25.95

*Innovation and Entrepreneurship*
by Peter F. Drucker
HarperBusiness, $13

BY STEPHEN D. SOLOMON




WHEN Bell Atlantic Corp. announced in October that it would merge with Tele-Communications Inc., the price tag of $30 billion-plus was just a down payment on the eventual investment needed to create the interactive age. Beyond laying cable, installing switches, and building the boxes that will sit atop television sets across the nation, companies will have to devote many billions more to developing the advanced electronics and software needed to make it all work and to make it all worthwhile to consumers.

If such efforts don't quite add up to a new golden age of R&D spending, developing the electronic superhighway does represent a major new technology challenge to three of America's most vibrant industries. Computer, telecommunications, and entertainment companies are puzzling over how to gain an advantage in a highly unpredictable field. Perhaps not since the invention of the microprocessor has technology been so ripe with possibilities—and with risk.

In this season of high stakes for high-tech companies, executives and managers would do well to consider how effectively they manage R&D projects. Two recent publications attempt to assist them. *Inventivity: The Art and Science of Research Management*, by John J. Gilman, discusses strategies for maximizing the productivity of R&D efforts. Gilman, who has directed research at Amoco, Allied-Signal, and Lawrence Berkeley Laboratory, where he is now a senior scientist, devotes most of his effort to quantitative analysis. He offers equations that purport to help managers with tasks such as optimizing research spending and figuring out the most efficient size for a research organization.

Some of this may be helpful for measuring R&D productivity in hindsight, but it is unlikely to aid companies in building effective research organizations. Equations, after all, have nothing to do with the wise management of people, the key resource of any technology company. Nor do equations help managers define the strategic focus of their company.

A second recent offering, *Learning to Manage Technical Professionals: Crossing the Swamp*, by Richard J. Stein, is easier going. Stein, a management consultant based in Redding, Conn., has written his book for engineers who have assumed heavy management responsibilities for the first time.

Stein emphasizes that successful technology managers manage people, not ideas, products, or paperwork, and that managers must leverage their time by delegating tasks. That this lesson is obvious does not make it less important; many people who rise through the engineering ranks to supervisory jobs continue old habits of tinkering, while their managerial duties suffer. Stein rightly points out that bench work is not work for which managers are paid. He also points out where some of the booby traps are buried. For example, to the manager who is devising a project timetable and requires outside services, he urges caution: "If your plan depends on getting some plumbing, wiring, or ventilation, take your most reasonable time estimate and triple it."

While Stein offers some useful nuggets, the book's primary weakness is that they remain just that, unpolished and undeveloped. There is little depth here and no organizing principle for managing technology ventures. If the equivalent of a list of do's and don'ts would be valuable to you—and it may well be, at least as a start—then take this book along as a companion on a short (very short) plane flight.

### Time-Honored Advice

But for companies that need more than equations or stray kernels of wisdom, Peter F. Drucker's *Innovation and Entrepreneurship*—a 1985 opus by the noted management expert—is well worth dusting off. Far from being dated, it has survived the past decade in considerably better shape than many *Fortune* 500 companies that ignored its lessons.

Drucker's book not only probes much deeper into R&D management but also contains a strong thematic principle. Much of the credit over the last four decades for elevating management to a discipline that can be organized and studied goes to Drucker, who has written a shelfful of books on the subject. In this volume he attempts, with considerable success, to do the same for innovation. Innovation, he argues, is not art, not inspiration, not a magical kiss by the Muse. It is a purposeful task that managers can organize in a way that maxi-



ILLUSTRATIONS: BRUCE MADDOCKS

mizes a company's chances of success.

The vision of top management is important, says Drucker, but by itself is not enough. Innovation "requires a good many people who know what they are supposed to do, want to do it, are motivated toward doing it, and are supplied with both the tools and continuous reaffirmation," he writes. "Otherwise there is only lip service; entrepreneurship soon becomes confined to the CEO's speeches."

Successful entrepreneurial management, Drucker argues, requires that organizations "be made receptive to innovation and willing to perceive change as an opportunity rather than a threat." He says that each manager must be, as a Latin poet once said of human beings generally, "*rerum novarum cupidus*"—greedy for new things. But how do you make them so?

For starters, companies must conduct periodic reviews that put every one of their products and activities on trial for their life. If some product is reaching the end of its day, managers must make sure the company's resources are not consumed in prolonging a glorious sunset.

Instead, managerial vision should focus on opportunity. Executives must meet regularly with junior people to hear their ideas. R&D projects must be organized separately and high up within the organization. "Even though the new project, by virtue of its current size, revenues, and markets, does not rank with existing products, somebody in top management must have the specific assignment to work on tomorrow as an entrepreneur and innovator," Drucker writes. New projects develop best, he says, when they are set up as a separate business.

Drucker is no less insistent on the importance of management when he turns his analysis to new companies as opposed to existing ones. Many company founders cling to the idea that a better mousetrap alone wins the game, and that solid management practices are somehow superfluous. Drucker reminds them that Thomas Edison himself paid dearly for such myopia. "He thought that 'managing' meant being the boss," Drucker writes. "He refused to build a management team. And so every one of his four or five companies collapsed ignominiously once it got to middle size, and was saved only by booting Edison himself out and replacing him with professional management."

A new company with a better mousetrap, in fact, has the greatest need for good managerial practice. Many companies that grow quickly collapse under the weight of their good fortune because they cannot control the various parts of their expanding business. The remedy, says Drucker, is to build a management team several years before the enterprise reaches the size and complexity to actually require it. A group of managers needs several years to develop the trust and mutual understanding to function effectively.

"Entrepreneurship is 'risky' mainly because so few of the so-called entrepreneurs know what they are doing," Drucker writes. "They lack the methodology. They violate elementary and well-known rules." His book still reigns supreme as a thoughtful, concise, and useful compendium of those rules.■

*STEPHEN D. SOLOMON, an associate professor of journalism and mass communication at New York University and a business writer, has served on the staffs of both* Inc. *and* Fortune.

BOOKS

# BRAINSTORMS

*Seized: Temporal Lobe Epilepsy as a Medical, Historical, and Artistic Phenomenon*
by Eve LaPlante
HarperCollins, $20

BY ROBERT FINN

THE *Brothers Karamazov*, *Alice in Wonderland*, *Messiah*, and *Starry Night* are among the cornerstones of cultural history. But if Eve LaPlante is correct, they are also manifestations of disease. The creators of these works, she writes in *Seized*, all suffered from temporal lobe epilepsy (TLE), a brain disorder that affects not only the health but also the personalities of those who are stricken with it. In her provocative portrait of a little-known disease, LaPlante, a Boston-area journalist, suggests that Dostoevsky, van Gogh, and a host of other artistic and religious figures derived their creative powers from the same brain disorder that caused their seizures. Hence, she argues, TLE is significant both because it may be an important cultural force and because, as a shaper of career choices and creative decisions, it challenges the very concept of free will.

TLE, like other forms of epilepsy, is caused by disordered electrical activity in the brain, the result of oxygen deprivation during birth, a brain infection, or even a sharp rap on the head. In the more common forms of epilepsy, seizures involve the whole brain and lead to unconsciousness and occasionally convulsions. But in TLE—of which there are thought to be roughly a million cases in the United States—the electrical storm is confined to portions of the temporal lobes. Those undergoing such seizures often remain fully conscious, although they may experience panic, confusion, hallucinations, or rage.

But the most interesting aspect of TLE is what happens between seizures. Circuits in the temporal lobe control language, emotions, and learning and memory, and TLE causes these circuits to activate abnormally even when a seizure is not raging. Norman Geschwind, the brilliant Harvard neurologist who died in 1984, described a constellation of five personality traits that often accompanies TLE. These traits are hyperreligiosity, hypergraphia (a compulsion to write copiously), "stickiness" (a form of extreme dependence on other people), aggression, and altered sexuality. Together they have come to be known as Geschwind's syndrome.

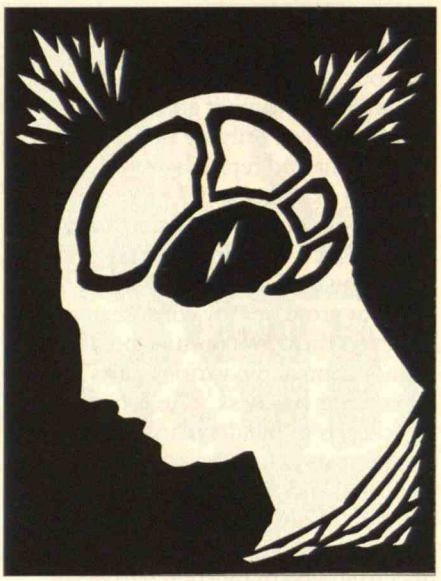
The historical evidence suggests that Vincent van Gogh had a classic case of Geschwind's syndrome. Before he

became a painter, van Gogh was a Protestant missionary who was fired from one post for his "excess of zeal bordering on the scandalous." His hypergraphia can be seen in his furious productivity—the hundreds of paintings and thousands of letters to his brother Theo that occupied the last years of his life. Van Gogh's "stickiness" showed up in his reliance on Theo and his desperate efforts to keep Paul Gaugin from leaving Arles, where they roomed together. In one epileptic rage, van Gogh menaced Gaugin with a straight razor, and in another he applied that same razor to his own ear, with famous results. And his altered sexuality took the form of a lack of interest in sex, although the disorder can lead others to become hypersexual.

Not everyone with TLE achieves greatness. LaPlante shows how the disorder has affected the lives of three ordinary people. "Charlie" is a distinguished Vermont lawyer and sometime judge long known for his meticulous attention to detail, a trait often associated with TLE. He had his first seizure in middle age, while chopping wood in the forest behind his house. He wandered, lost in the familiar woods, for hours until his wife found him. This false feeling of unfamiliarity is called *jamais vu* and is the flipside of *déjà vu*, which is also common in TLE. Charlie has a fairly mild case that is well controlled by anticonvulsant drugs.

"Jill" has a more severe case of TLE, sometimes suffering three or four seizures a day, and drugs don't help her much. When a seizure overtakes her, she becomes riveted with fear, and sometimes sits at her desk motionless for hours until she summons the courage to move. She recently quit her job as a personnel manager to become a full-time sculptor, although she never before showed artistic interest or aptitude. She'll probably never know whether her newfound artistic vocation was induced by diseased brain tissue.

"Gloria" suffers 60 to 100 seizures a day, despite drugs and neurosurgery. She has been incarcerated for violent



outbursts, and is well known in the corridors of Boston's City Hall, where she frequently accosts officials to complain about perceived injustices.

Physicians use anticonvulsant drugs such as phenobarbital and Dilantin to control the disorder, but drugs seem less effective in TLE than in other forms of epilepsy. In severe cases like Gloria's, neurosurgeons attempt to remove sections of the temporal lobes—sometimes as large as a fist—that contain the scarred brain tissue responsible for TLE. These surgeries often relieve the seizures, but occasionally have no effect and sometimes even make the problem worse. Crude as today's methods are, earlier treatments for TLE were much harsher. In the most horrifying chapter, LaPlante describes some of these, which, a century ago, included castration for men and clitoridectomy for women; for many years the disorder was believed to result from excessive masturbation.

### Diagnosing Across Time

Unfortunately, LaPlante is at her least persuasive where she needs to be most persuasive: in attributing TLE to various historical figures. In some sections of the book, each new page brings mention of another legendary personage she has diagnosed with TLE through the mists of history. Many great religious leaders are supposed to have been sufferers, including Moses, Saint Paul, Joan of Arc, Mohammed, even the Buddha. So are many major literary lights of the last few centuries, including Lewis Carroll, Flaubert, Molière, Petrarch, Dickens, and Proust. And so are artists, musicians, and philosophers such as Delacroix, Handel, Paganini, Socrates, Strindberg, Pascal, and Kierkegaard.

Physicians sometimes find TLE difficult to diagnose when a patient is sitting in front of them, available for sophisticated medical tests. Even electrodes implanted deep within a patient's brain occasionally fail to pick up the abnormal electrical activity associated with the disorder. The brain scars that cause TLE are often invisible at autopsy. How, then, can one make accurate diagnoses, hundreds or thousands of years postmortem, of historical and biblical figures, based on legends of their lives? The medical evidence on van Gogh and Dostoevsky is fairly complete and convincing. But LaPlante's diagnosis of Moses—to take another example—rests largely on his claims to have talked with God and his reputation for having a bad temper.

Instead of bolstering the argument that TLE has had an important influence on our cultural heritage, each additional diagnosis has the paradoxical effect of engendering stronger skepticism. Does everyone who keeps a diary merit a diagnosis of "hypergraphia"? Is everyone who is fervently spiritual suffering from a brain disorder that causes "hyperreligiosity"? For that matter, is Charlie's attention to detail pathological, or is it merely the hallmark of a conscientious New England lawyer?

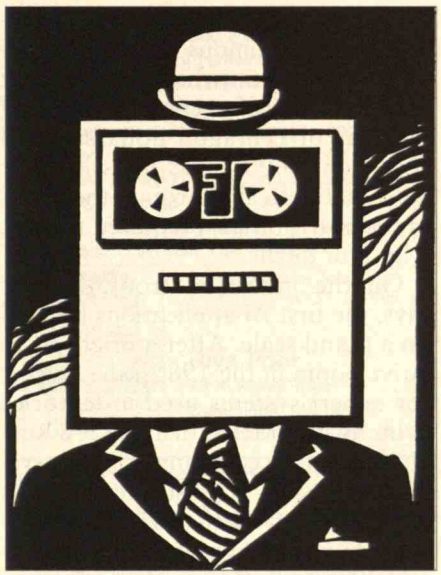
Nevertheless, if one can accept that TLE causes certain feelings and behaviors, one can't help wondering how many other human traits stem from uncontrollable brain processes. On the one hand, LaPlante seems overeager to brand common experiences as pathological. For example, she recounts approvingly a lec-

ture by Paul Spiers, a neuropsychologist and prominent TLE researcher. "How many of you in this room have had a *déjà vu*?" Spiers asked his class. When more than half his audience raised their hands, he said, "Welcome, fellow epileptics." Spiers believes that *most* people have, if not actual seizures, then periods of abnormal electrical activity in their brains, and these account for such things as paranormal or out-of-body experiences, the feeling of being watched, and even ringing in the ears. But if one's every unusual experience or bright idea is considered the result of a seizure, then the term loses all meaning.

On the other hand, LaPlante is safe in concluding that the concept of self-determination is not as unassailable as most of us want to believe. "Like the ancient concept of fate," she writes, "TLE challenges the notion that one can willfully create the self." Van Gogh and Gloria had no control over the abnormal brain activity that evidently shaped their lives. But is *normal* brain activity any more controllable? Clearly, people cannot consciously manipulate the electrical impulses that govern their every thought and action. At best, say many neuroscientists, consciousness is like a high-level computer language that is somehow translated into the low-level machine code that actually controls the hardware. But at worst, consciousness may control nothing at all. Some researchers believe that it may be a kind of illusion, a post hoc rationalization of decisions our brain circuits make automatically without the intervention of the external agent we think of as our minds. And if our brains make decisions without the intervention of consciousness, how can we be said to possess free will any more than a person in the grips of TLE?

The main contribution of *Seized* may lie not in the answers it attempts to provide about the lives of historical personages but in the questions it raises about ourselves. ■

*ROBERT FINN is a science writer based in Pasadena, Calif. As a graduate student, he studied the neurobiology of learning and memory.*



BOOKS

# MACHINE DREAMS

*AI: The Tumultuous History of the Search for Artificial Intelligence*
by Daniel Crevier
Basic Books, $27.50

*In Our Own Image: Building an Artificial Person*
by Maureen Caudill
Oxford University Press, $23

BY ROBERT J. CRAWFORD

THE promise of artificial intelligence—self-directing machines that perform tasks requiring "intelligent" decisions—has attracted a corps of devoted enthusiasts. From tinkerers in academic enclaves to the factory floor, artificial intelligence (AI) pioneers have ridden several cycles of boom and bust, each time claiming that "the revolution" is just around the corner. Like the scientist-entrepreneurs of the biotechnology industry, they must now work hard to sell their ideas to governments, manufacturers, and the public.

Two efforts to boost the young science are *AI*, Daniel Crevier's chronicle of the field's "tumultuous" development, and *In Our Own Image*, Maureen Caudill's exploration of the prospects for a neural-network android mind. Both books are thought-provoking and accessible. Both promise a revolution that is (still) just around the corner. And both acknowledge that artificial intelligence, after many false starts and exaggerated claims, is a tough sell.

Where the books differ is in the way they attempt to overcome the skepticism surrounding the field. Crevier squarely faces AI's checkered history, arguing that practitioners of the established form of artificial intelligence—an approach called symbol processing—have learned from their mistakes and are ready to carry on. Caudill makes a clean break with the past. Symbol processing, she argues, has failed to replicate human intelligence because it is simply not up to the task; the solution lies in the newer branch of AI known as neural networks. Neither author, however, makes a convincing case that artificial intelligence can approach the complexity and flexibility of the human brain.

### Bleeps, Bloops, and Blunders

Crevier, a professor of electrical engineering at the University of Quebec, is also the founder of an AI company specializing in computer vision. He attempts to forecast the future of the field by examining the efforts of the first generation of artificial intelligence researchers.

The AI pioneers of the mid-1950s believed that thought consisted of "symbol structures," flexible translations of the outside world for the brain; intelligence arose from their purposeful manipulation. These researchers assumed that thinking, learning, feeling—anything an intelligent human does—could be scientifically described and then programmed into a digital computer. For the next 20 years, this symbol-processing methodol-

ogy (also known as hard AI) defined the terms, and perhaps the limits, of AI research.

It was a crucial stroke of luck, as Crevier demonstrates, that transformed this embryonic discipline into a major movement: the tensions of the Cold War. By the mid-1960s the Pentagon was pouring millions of dollars into AI research each year, attracting many of the best young researchers to a field that promised to build automated translators of human speech, smart bombs that could swap information and switch targets according to split-second military priorities, and other equally intelligent devices.

Expertise that was developed with military funding quickly overflowed into the civilian sector. Early laboratory successes included DENDRAL, an "expert system" that proved remarkably adept at exploring the structure of complex organic molecules. Smart game programs such as Deep Thought and MacHack were soon beating backgammon champions and eventually chess masters.

Yet these first tentative forays into duplicating human intelligence were often blown out of proportion. Feeding on the gullibility of military funders and members of the popular press, many AI pioneers touted even minor achievements as harbingers of a brave new world. In 1970, for example, "Shakey," a simple "hand-eye robot" assembled at Stanford that could stack wooden blocks, was hailed by *Life* magazine as "the first electronic person."

Lurking beneath the hype were design flaws that have plagued hard AI to this day. Outside of narrowly defined "micro worlds," Crevier reports, symbol-manipulating AI programs were very stupid indeed. Programmers were forced to anticipate the consequences of every "intelligent" action to the smallest detail, an impossible task for real-world situations. And because AI programs didn't really understand the procedures they carried out, they apparently could not be taught common sense. For example, the Autonomous Land Vehicle, a "smart truck" on which development ceased in 1989 after consuming tens of millions of Pentagon dollars, could travel only 600 yards unassisted; it was unable to sift through the thousands of hypotheses required to skirt a bush or ditch.

On the industrial front, Crevier says, the first AI applications flopped on a grand scale. After a brief speculative boom in the 1980s, the market for expert systems used in factories brutally contracted, leaving few surviving start-up companies. Expert systems—basically sophisticated catalogs of "if . . . then" scenarios—eventually sagged under the weight of continually added instructions, and became too expensive for manufacturers to maintain and reprogram.

In Japan, the Fifth-Generation Project, which officials of the Ministry of International Trade and Industry boasted would leapfrog American AI capabilities, turned into an $850 million dud. Based on a rigidly logical programming approach called PROLOG, it failed to capture the illogical, intuitive side of human intelligence and resulted in computers that were no better than existing ones. Not surprisingly, governments began pulling the plug on many hard-AI investments.

Despite its critical defects, Crevier believes that hard AI will continue to improve. Today, extremely simple expert systems embedded in commercial software programs can make nonspecialists like sales clerks or repairpeople "smarter," instantly furnishing them with lists of options and up-to-date information to help them make decisions. This technology may one day expand into more sophisticated applications.

Like what? There's the rub. Although he writes confidently that faster machines and improved hardware will generate ever more useful lists of possible solutions to problems in a wide range of fields, Crevier remains infuriatingly vague about how this might be accomplished. In the end, we have only his unquestioning faith in "better technology."

### I, Robot

Maureen Caudill, research director of New World Financial, a southern California company that develops neural-network software for financial groups, represents a new generation of artificial intelligence entrepreneurs who believe that the symbol-processing approach will forever limit the intelligence of machines. *In Our Own Image* is an enthusiastic treatise on the potential of neural networks to evolve an intelligent machine mind. But Caudill's argument proves to be no less rooted in faith than Crevier's.

While symbol-processing AI systems perform according to preprogrammed rules ("what goes in is what comes out"), neural networks learn the rules as they go along—a trait that Caudill believes is much closer to the way the human mind works. Like people, these collections of tiny processors can be trained by repetition. The strength of the connections between processors is automatically adjusted until the neural network performs the desired task or gives the right answer to a question. Also like people, neural networks respond to stimuli from the world around them. Signals from cameras, microphones, or tactile sensors can give them the feedback they need to do their job.

An example is INFANT, a robotic arm developed by Neurogen, in Brookline, Mass., that learns to touch and manipulate objects as if it were a child. Here a neural network—outfitted with "eyes," some ability to "feel" with its fingers, and motor ability for lifting—learns by trial and error to behave as its inventors want it to. Other neural nets have been trained to read texts in a humanlike voice, to evaluate mortgage applications, to diagnose engine trouble in automobiles, and to sniff out explosives at airports.

Such systems, at least in theory, are ideally suited to meet the "minimal requirements" for an android, or artificial human. It must, Caudill says, be able to interpret what it sees, feels, and hears—remembering important information and obeying with some common sense the social dictates of the human world—and be able to move around autonomously.

But there is a slight problem. Like symbol-based AI systems, neural networks have so far been unable to function outside the rigid confines of their expertise. Caudill assumes that neural networks will somehow develop "higher" mental functions like creative problem-solving or the recognition of cultural context. Lacking these, the human-like intelligence and consciousness that she believes will evolve remain an unimaginable quantum leap. Given the present state of the art, Caudill's prediction that a working android, however primitive, will be "built shortly after the turn of the century" sounds like a pipe dream, and her belief that androids will someday "take over much of their own development and reproduction" seems to rest on little more than boundless optimism.

This optimism—the mark of a convinced technology booster—runs through both books. It leads Crevier, after a brief examination of the history of industrialization, to blithely theorize that AI-caused unemployment will be "self-correcting." And it leads Caudill to make simplistic assumptions about human psychology. Creativity "has something to do with applying old concepts . . . in new ways," she writes, ignoring the crucial role of the unconscious mind and unusual associations. Perhaps the authors' optimism reflects the inevitable tensions of dedicated pioneers who must develop their disciplines while courting investors. But the result is a brand of technology forecasting that takes its cues from Bing Crosby: accentuate the positive, eliminate the negative, and don't mess with Mr. In-Between. ■

*ROBERT J. CRAWFORD is assistant director of Harvard's Office for Sponsored Research.*

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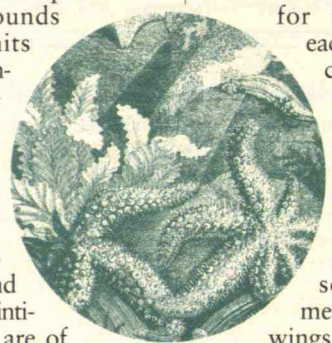
# Phenomena

By David Brittan

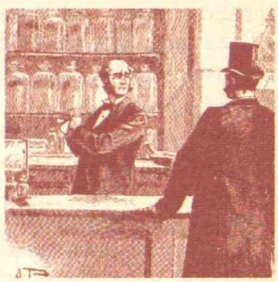
**A Bat's Life** Cynthia Moss doesn't wear a cape, but she is something of a crusader on behalf of the perceptual abilities of bats. At issue is how much the nearsighted mammals can learn about their surroundings by emitting ultrasonic pitches and listening to the echoes. Many researchers believe that the world of the bat consists of little more than "different-sized blobs." To Moss this conclusion is, well, myopic: "I think bats experience an acoustic 'scene,' in many ways similar to how we experience the world using vision." She points to mounting evidence that the animals can distinguish fine details and surface textures, as well as keep track of many moving objects at once. Toss up a handful of mealworms, and a bat will snatch them out of midair. Mix in some inedible objects, and the bat will go straight for the worms. Moss's research at Harvard University, where she is an assistant professor of psychology and neuroscience, shows that North American big brown bats can detect half-microsecond changes in the timing of echoes, equivalent to changes in distance of a tiny fraction of a millimeter. What's more, she says, they can sort out echoes bombarding them from many different directions, allowing them to gauge how widely objects are separated. This would explain how a bat can chase insects through tree branches without getting snagged. Although no one knows what the final "display" looks like to the bat after its brain has processed all the incoming echoes, Moss guesses that the creatures build up a spatial picture every bit as detailed and vivid as a medical ultrasound image.

**Tales from the Deep** While neuroscientists probe the minds of bats, marine scientists have begun listening in on the private lives of fish. The Spawn-O-Meter, developed at the Woods Hole Oceanographic Institution, does just what its name implies. Positioned over ocean breeding grounds, the instrument picks up underwater sounds and transmits them to a computer programmed to detect various clicks and grunts fish make when they release eggs and sperm. These intimate details are of obvious value to fisheries and to custodians of marine parks and reserves. But they are also useful for environmental monitoring: changes in spawning habits can be an early sign of water pollution.

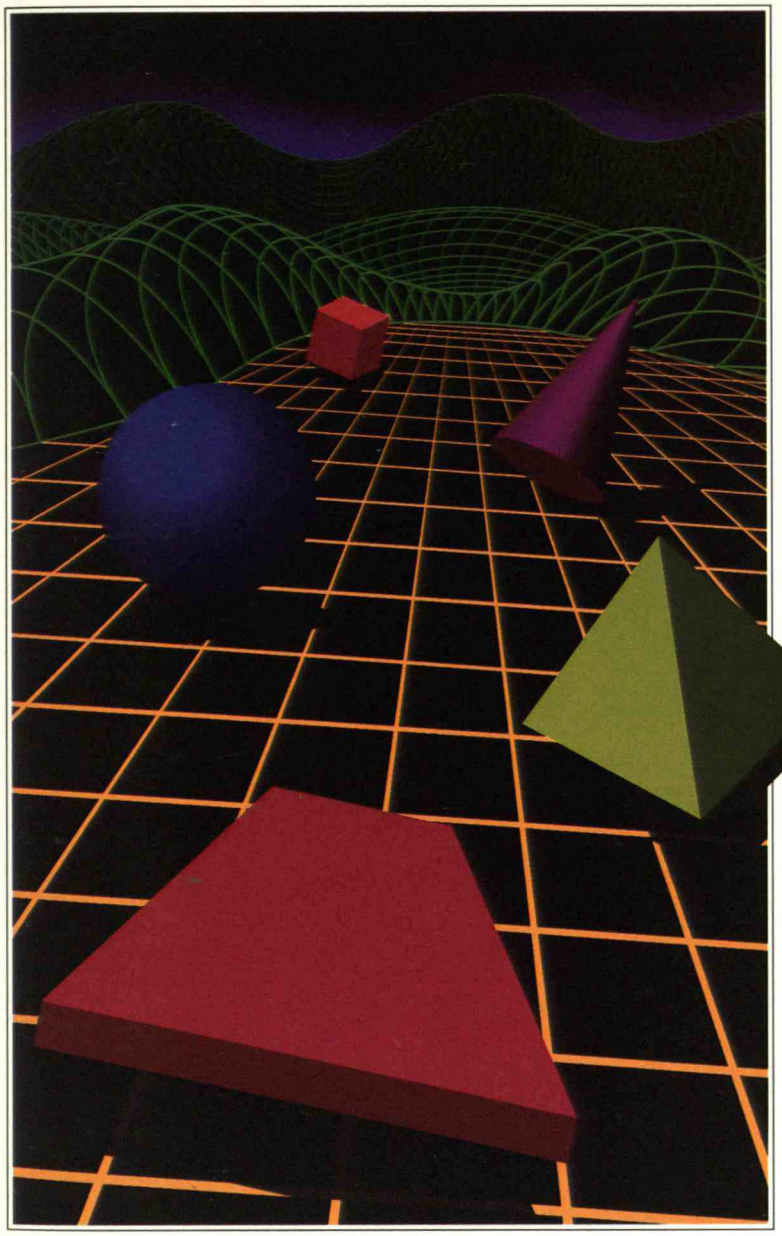


These days, even NASA is looking out for the welfare of sea creatures. In a joint experiment initiated by the Virginia Institute of Marine Science, the space agency's Langley Research Center recently put its aeronautical expertise to work helping marine life at the bottom of Chesapeake Bay survive a long, hot summer. An array of buoyant airplane wings anchored 30 or 40 feet beneath the surface churned up the top layer of water, which in warm weather just sits there, like smog over the LA Basin. In water currents, a wing behaves exactly as it does in air currents: it generates wake vortices—"a pair of horizontal tornadoes," as NASA project manager George Greene puts it. Wake vortices from the 20-foot wings can help transport oxygen from the water's surface to marine animals on the bottom, and may be borne 1,000 feet downstream on underwater currents. Greene estimates that the wings could be built in large quantities for about $1,000 each. "If you had a couple of acres of oysters that were worth a few million bucks," he says, "then a few thousand dollars seems like a very reasonable investment." Two of the wings are now roiling the waters of a mussel farm in Maine.

**All the Flux You Can Eat** Speaking of wake vortices, the microelectronics industry has run into some turbulence of its own. Many toxic or environmentally harmful compounds on which the industry has come to rely are now on the endangered-chemical list. Searching for a nontoxic solder flux—the medium in which solder for attaching components to circuit boards is suspended—AT&T Bell Laboratories chemist Yinon Degani decided to look for ingredients unlikely ever to be banned. He scoured the shelves of a New Jersey supermarket, reading the labels of chewing gum, candies, cosmetics, and headache remedies to learn which substances were widely used. Then, aided by chemical databases, he picked the ingredients with the most suitable properties for fluxes. Glycerin, for example, can serve as a solvent, and vegetable gums can act as a thickener. "Aspirin makes an excellent activator," says Degani. AT&T has already replaced the chlorofluorocarbons in its circuit-board cleaners with derivatives of orange peel and cantaloupe. Can chocolate chips be far behind?



**Let There Be Stripes** Merrill Allen, a professor emeritus of optometry at Indiana University, is on a crusade to eliminate another environmental hazard: hard-to-read traffic signals. One male in ten, he says, has a form of colorblindness that makes red and green indistinguishable, and one in fifty can't see red at all, regardless of its brightness. Allen's solution: put a white stripe through each light—vertical for green and horizontal for red. An earlier innovation that Allen championed—the high-mounted brake lights now standard on U.S. vehicles—cut rear-endings by 17 percent. He predicts that striped traffic signals would reduce intersection accidents by about 10 percent. So far, says Allen, highway administrators have been loath to tamper with the status quo. But still, added to Cynthia Moss's efforts at Harvard, Allen's crusade raises to two the number of visually impaired mammals for whom someone is at least going to bat.



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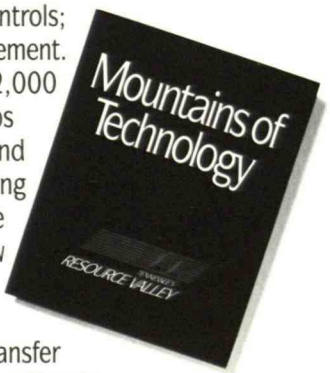


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